Vol. 14, No. 21
November 15, 1989

Energy Research Abstracts

Abstracts 44407–46789

Office of Scientific & Technical Information
UNITED STATES DEPARTMENT OF ENERGY

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Vol. 14, No. 21
November 15, 1989
ISSN: 0160-3604
CODEN: ERABD

Energy Research Abstracts

Purpose

Energy Research Abstracts (ERA) provides abstracting and indexing coverage of all scientific and technical reports, journal articles, conference papers and proceedings, books, patents, theses, and monographs originated by the U.S. Department of Energy, its laboratories, energy centers and contractors. *ERA* also covers other energy information prepared *in report form* by federal and state government organizations, foreign governments, and domestic and foreign universities and research organizations. Foreign information is obtained through the International Energy Agency's 14-nation Energy Technology Data Exchange, the International Atomic Energy Agency's International Nuclear Information System, or nation-to-nation agreements. **Please note that *ERA* coverage of non-report literature is limited to that generated by Department of Energy activity.**

Scope

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The citations presented in *ERA* are available for on-line searching as records within the Energy Data Base. The current-year records are available on the Integrated Technical Information System (ITIS). The entire data base is available through commercial on-line vendors.

Availability

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ERA is available to the public on a subscription basis from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The subscription rate for 24 semimonthly issues is $184.00 for domestic subscribers and $230.00 for foreign subscribers. A single issue costs $27.00, domestic, or $33.75, foreign. Cumulative indexes are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. The GPO Stock Number is 661-000-00000-7 and the price is $174.00 for the Volume 13 indexes.

Managing Editor, Audrey B. Smith
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Information Sources

The citations presented in *Energy Research Abstracts* are a subset of the worldwide energy information provided to the Office of Scientific and Technical Information (OSTI) through exchange agreements with foreign sources and through exchanges or contracts with U.S. organizations.

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In the exercise of its rights and responsibilities under the agreements to which it is a party, the **Office of Scientific and Technical Information** both receives information from the above sources and submits U.S.-produced information to them. In addition to materials generated by the Department of Energy, this U.S.-produced information is gathered from other government agencies as well as under contract with private information processing companies. All input is computer processed and entered into a data base for on-line retrieval. The data base serves as well for the production of numerous OSTI publications.

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The coverage of literature in this publication includes several document types, ranging from technical reports to journal articles to books. The principal data elements included in these citations are:

1. **Abstract number** within volume.
2. **Report number** identification for report-type literature.
3. **Title and subtitle** (non-English title may appear in parentheses, if applicable).
4. **Author(s).** First 10 names in the data record are printed, then "et al." is listed.
5. **Author affiliation.** Only first one is listed, in parentheses after author(s) to which it applies.
6. **Collaboration,** if present.
7. **Corporate author(s)** identifying corporation responsible for document.
8. **Patent assignee and number** for citations of patent documents or applications.
9. **Journal title, volume, and issue** for citations of journal articles.
10. **Date of publication.** If not known, a processing date is in brackets.
11. **Number of pages** or page range.
12. **Language** of document if non-English.
13. **Monograph title** if citation is an analytic (part, chapter, or paper) of a larger monograph.
14. **Publisher's name and location** for documents published by a corporate or commercial source.
15. **Sponsoring organization.**
16. **Contract or grant number.**
17. **Secondary identifying number;** may be a conference number.
18. **Conference title, location, and date,** if applicable.
19. **Order number.** The "DE" order number may be used for ordering from NTIS or OSTI, as appropriate. The "TI" prefix is valid only at OSTI.
20. **Sources of availability** from which a copy of the document may be obtained; usually appear as abbreviations. (See information on following page.)
21. **Drop note** or explanatory statement.
22. **Abstract.**
23. **Subject descriptors.** Listed only if no abstract or only a brief statement is included.

Sample Citations

Report

18494 (DOE/ER/40438–T1) **[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report.** Haeberli, W. Phys. VI collaboration. Wisconsin Univ., Madison (USA). Dept. of Physics. [1989]. 12p. Sponsored by DOE Energy Research. DOE Contract FG02-88ER40438. Order Number DE89007246/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper briefly discusses the Wisconsin test facility for storage cells; results of target tests; the new UHV...

Report Analytic

18500 (INIS-SU—69, pp. 30-32) **Transition energies in Ne-like ions. Correlation effects.** Vainshtejn, L.A. AN SSSR, Moscow. Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics. Collection.* Order Number DE89780060/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS. Kratkie Soobshcheniya po Fizike.; no. 6.

SILVER IONS/energy-level transitions; XENON IONS/energy-level transitions; CORRELATIONS; D STATES; E STATES;...

Journal Article

19055 **A theoretical and experimental investigation of long-pulse, electron-beam-produced rare gas plasmas.** Brake, M.L.; Repetti, T.E. (Energy Beam Interaction Lab. of the Dept. of Nuclear Engineering, Univ. of Michigan, Ann Arbor, MI (US)). *IEEE (Institute of Electrical and Electronics Engineers) Transactions on Plasma Science (USA),* 16(5): 581-589 (Oct 1988). (CONF-881020–: Symposium on radiation physics, Sao Paulo, Brazil, October 3, 1988). Visible emission spectroscopy (380-650 nm) has been performed on intense, electron beam (1 kA, 300 ns, 300 kV) produced Ar, Kr,...

Patent

18045 **Polarization of fast particle beams by collisional pumping.** Stearns, J.W. To Dept. of Energy, Washington, DC. USA Patent 4,724,117. 9 Feb 1988. Filed date 19 Oct 1984. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method for polarizing a fast beam of particles by collisional pumping, comprising the steps of generating a beam...

How To Order from the Availability Sources

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Report literature, usually identified by an alphanumeric identifier at the beginning of a citation, is available from the sources listed in the citation (see example of element 20 on page iii). Often the sources are listed as abbreviations. Corresponding addresses are provided at right from which documents with these abbreviations may be ordered. When "OSTI" is given, **DOE and DOE contractors may order these documents from OSTI.** (However, check with your library or information organization which may require that orders go through them to OSTI.) The public should order from NTIS or from one of the other agencies listed in the citation. To expedite processing, an order form is provided in the back of this publication. NOTE: The order numbers provide quicker access for report ordering. Use the order number where possible.

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Books, conferences, and monographs The source for these publications is the publisher or the originating society, organization, or institution. DOE-supported conferences and individual papers reporting DOE-supported research may be available as reports from OSTI.

Foreign material The Linda Hall Library is an excellent source of foreign materials. For translations of foreign language material, contact the John Crerar Library. For material difficult to locate, check with the British Library Document Supply Centre.

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United Kingdom

How To Use the Indexes

Five indexes are provided for approaching the content of each issue of *Energy Research Abstracts*. Descriptions of entries in these indexes follow.

Corporate Author Index
The corporation, organization, or institution responsible for the issuance of the document is listed in this index. The entries are arranged alphabetically and provide the title and citation number of the reference. For example, the listing for the "Report" sample citation would appear as shown at right.

Wisconsin Univ., Madison (USA). Dept. of Physics
[Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)
Wisconsin Univ., Madison (USA). Lab. of Genetics
Organization of the R chromosome region in maize: Final progress report, June 1, 1983–May 31, 1986, 14:18255 (R;US)

Personal Author Index
Each author's name listed on a document cited in this issue is indexed. An index entry provides title and citation number; for secondary and other names, a cross-reference is given to the primary author name where the full index entry is located.

Hadley, D.L., *See* Lee, A.D., 14:17651
Haeberli, W., [Development of a hydrogen and deuterium polarized gas target for application in storage rings]: Progress report, 14:18494 (R;US)

Subject Index
This index lists the main subject descriptors assigned to each record by indexing professionals. A secondary or qualifier term is used where necessary to describe materials, objects, and processes. Document titles may be enhanced with additional informative phrases where necessary. An excerpt from this index appears at right.

HYDROGEN ISOTOPES
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HYDROGEN 4
TRITIUM
Neutron-Rich Isotopes
Study on the strong neutron-rich nuclei of lightest elements, 14:18686 (RA;SU;In Russian)

Contract Number Index
DOE technical reports are listed by contract number. Each entry also provides the primary corporation or organization cited for that contract number. A typical entry is shown.

FG02-88ER40438 **Wisconsin Univ., Madison (USA). Dept. of Physics**
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Report Number Index
Technical report literature is indexed by the alphanumerical identifier of the report. Patent documents and conferences are included for convenience. Each entry lists the citation number, the source of availability of the document, an indicator of presence at a GPO depository library, order number, and distribution category. A typical entry is:

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Subject Contents

The subject content of *Energy Research Abstracts* is arranged as shown below. The two-digit and four-digit category numbers printed here illustrate the category number assignment used in the data base records.* The following list includes all of the 40 first-level and the 289 second-level categories. Because each issue of *ERA* publishes citations only for those documents announced during the past semimonthly period, some subject categories may not be present in every issue.

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*The numerical subject category scheme is used in the storage, retrieval, and manipulation of bibliographic information entered into DOE's data systems. Categories and definitions for the complete set of six-digit numbers are given in DOE/TIC-4584, *Energy Data Base: Subject Categories and Scope.*

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Energy Research Abstracts

01 COAL AND COAL PRODUCTS

44407 (NEI-FI–74) **Background information of fuel peat.** Vapo Oy, Jyvaeskylae (Finland). Feb 1989. 18p. (In Finnish). Order Number DE89787738/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The publication gives basicn of fuel peat. The informatio information is collected from official statistics and committee reports. The subjects are: Energy policy in Finland; the price of fuel peat; production and utilization of peat and land uses; the proportion of peat energy of the total energy consumption on Finland; the investments done in the peat production and utilization; how the production of peat affects the employment; utilization of peat bogs after finished peat production; use of surface peat in environmental care; environmental effects of peat production such as effects on water courses; emissions orginating from peat combustion including the emissions of sulphur, nitrogen, carbon dioxide, hydrocarbon and also of dust and other solids; peat and the atmospheric carbon dioxide. (21 refs).

44408 (VTT-TIED–941) **Bibliography of Finnish biomass and peat literature 1986-1987.** Alakangas, E.; Luoma, H. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 97p. (In Finnish). Order Number DE89787759/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

This bibliography is a collection of citations from Finnish literature dealing with energy use of peat and biomass, collected during 1986 and 1987. The citations have been made in English because they were abstracted for international databases, such as BIOMASS, NEI (Nordic Energy Index) and DOE ENERGY. Collection of citations is a part of information service of International Energy Agency's (IEA) Biomass Conversion Technical Information Service (BCTIS). dissemination of information relating to all aspects of biomass energy including cultivation, harvesting, materials handling, conversion techniques and environmental and economic aspects. The bibliography contain 226 references. The citations contain bibliographic information and abstract. The keyword index is included.

0103 Preparation

44409 (DOE/FC/10626–2736) **Ash separation by induced electrical properties of low rank coal: Final report.** Advanced Energy Dynamics, Inc., Natick, MA (USA). Dec 1988. 176p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-85FC10626. Order Number DE89016555/JAW. Available from NTIS, PC A09/MF A01 - OSTI.

The contract objective was to determine the feasibility of separating finely dispersed minerals from low-rank coals using differences in electrostatic properties of the organic/inorganic components. Three coals were selected and tested, a moderate-ash lignite, a high-ash lignite, and a moderate-ash Western subbituminous coal. These coals were tested on two different types of separators, the Fine Coal (FC) corona-drum separator and the Ultrafine Coal (UFC) cyclone/disc separator. With the FC separator the particles are deposited on top of a rotating drum and are given a charge by corona, attracting them to the charged drum. Differences in conductivity between organic and inorganic material are the basis for the separation. With the UFC Separator, the particles are introduced pneumatically into a ceramic cyclone, and charged triboelectrically (by friction) through particle-to-particle and particle-to-cyclone wall contact. The coal particles charge positively and the ash particles charge negatively. From the bottom of the cyclone the charged particles are directed into an electric field between two oppositely charged rotating discs. The coal goes to the negative disc and the ash to the positive disc. Scrapers clean the discs and direct the coal and ash into separate receptacles. The three test coals were crushed in a hammermill and sized by air classification or jet sieve. Centrifugal float/sink tests were performed to determine the approximate maximum physical separation possible for a given size and coal. The different size cuts were then used as feeds for the electrostatic FC and UFC processes. Petrographic analyses and elemental analyses were conducted on selected samples and feed and separation products were analyzed for ash, sulfur, moisture and in some cases, Btu content.

44410 (DOE/PC/88884–T2) **Pitt Mill demonstration: Quarterly technical progress report, January–March 1989.** EXPORTech Co., Inc., New Kensington, PA (USA). Jul 1989. 29p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88884. Order Number DE89015999/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During the course of the work of Task 3.3.1, Screw Configuration, we learned that the Pitt Mill product produced in the early stages of grinding can contain significant amounts of +100 mesh material, depending upon the nature of the tests. Accurate analysis of the coarse fractions is important to understanding of the Pitt Mill operation. At the completion of Task 3.3.1 we converted to a Leeds & Northrup Model 7997-MTRAC II particle size analyzer. The new analyzer is capable of particle size analysis from 700 microns down to 0.9 microns. The instrument makes these measurements with 20 channels of information and replaces the Leeds & Northrup SRA 7995 model formerly used which has a top size limitation of 175 microns and a resolution of 15 channels of information. The 7997-MTRAC II is effective when there is little +20 mesh material present. A study was undertaken to compare results obtained using the two particle size analyzers. Sample splits taken from two Pitt Mill runs were used as test material. Results of the comparison are presented in Figure 1. Mean particle size determinations with the 7997-MTRAC II are smaller than those of the SRA 7995 because the new analyzer reports measurements down to a smaller channel (0.9 microns). 13 refs., 9 figs.

44411 (DOE/PC/88884–T3) **Pitt Mill demonstration: Quarterly technical progress report, April–June 1989.** EXPORTech Co., Inc., New Kensington, PA (USA). Jul 1989. 27p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88884. Order Number DE89015591/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Task 3.3, Pitt Mill Configuration Studies, was completed during this period. This report presents the results of the last experiments in Task 3.3 which investigated effects of agitator speed, loss of grinding media, transient profiles for particle size and ash content inside the prototype, effects of grinding chamber aspect ratio, and a number of other parameters which affect screw performance. The work under this task includes particle shape analysis and petrographic characterization of Pitt Mill and Jar Mill samples taken at different stages of grinding. The report also covers a description of coals recently procured and prepared for use in the upcoming Grinding Comparison Study, Task 3.4. 14 figs., 11 tabs.

44412 (DOE/PC/88886–T3) **Development of an advanced process for drying fine coal in an inclined fluidized bed: Technical progress report for the third quarter, April 1, 1989-June 30, 1989.** Boysen, J.E.; Barbour, F.A.; Turner, T.F.; Cha, C.Y.; Berggren, M.H.; Jha, M.C. Western Research Inst., Laramie, WY (USA). Jul 1989. 51p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88886. Order Number DE89015589/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This research project is for the development of a technical and economical feasible process for drying and stability fine particles of high-moisture subbituminous coal. Research conducted in this quarter focused upon thermogravimetric analysis (TGA) of both feed coals; continuation of the bench-scale IFB drying experiments; and initiation of the characterization of the products from the bench-scale drying experiments to determine their moisture reabsorption, dustiness, and spontaneous ignition properties. Thirty 4-hr and six 12-hr bench-scale IFB drying tests were conducted this quarter making a total of forty-one 4-hr (19 using Eagle Butte feed coal and 22 using Usibelli feed coal) and six 12-hr (3 using each feed coal)

tests conducted thus far. IFB reactor slopes of 3, 6, 9, 12, and 15 degrees were investigated for each feed coal. During the tests using Eagle Butte coal, gas-to-solids ratios ranging from approximately 0.7 to 9.7 lb/lb (kg/kg) and average IFB reactor temperatures ranging from approximately 370 to 700°F (188 to 371°C) were tested. 5 refs., 41 figs., 7 tabs.

44413 (DOE/PETC/TR–89/8) **Evaluation of reverse coal-pyrite flotation for a proposed Ohio advanced coal-cleaning test facility.** Miller, K.J. USDOE Pittsburgh Energy Technology Center, PA (USA). Coal Preparation Div. Jul 1989. 14p. Sponsored by U.S. DOE Fossil Energy. Order Number DE89016405/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A laboratory test program was conducted at the Pittsburgh Energy Technology Center with precleaned and classified middlings samples of three high-sulfur Ohio coals. The test program was run to evaluate the possible application of the US Department of Energy's two-stage reverse coal-pyrite flotation process in a new coal-cleaning test facility to be built in Ohio by the Ohio Coal Development Office. Results showed that the pyritic sulfur content of all three of the prepared coal samples could be substantially lowered via the coal-pyrite flotation process. But with two of the three coals, the organic sulfur levels were so high that removal of all of the pyrite would have contributed little to total sulfur reduction. Thus, processes aimed at pyritic sulfur reduction alone (such as the reverse coal-pyrite flotation process) would have limited impact on total sulfur reduction with some Ohio coals. However, with other coals in which sulfur is predominantly in the form of pyrite and marcasite, the process would likely prove beneficial. Therefore, the inclusion of reverse coal-pyrite flotation circuitry in the new facility would be prudent, especially since the proposed advanced coal-cleaning test plant will contain other deep-cleaning circuitry to ensure maximum ash reduction to achieve the lowest possible SO_2 per Btu emission levels. 13 refs., 2 figs., 6 tabs.

44414 (ETDE-mf–9914958) **Development of a jig for superfine material (carrousel-type jig) for the separation of sulfur carriers from coal. Final report.** Wirkus, W. Kloeckner-Humboldt-Deutz A.G., Koeln (Germany, F.R.); KHD Humboldt Wedag A.G., Koeln (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Aug 1988. 33p. (In German). Contract BMFT 0326484 A. Order Number DE89914958/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Research work done by the Technical University Clausthal/FRG as to jigging of superfine grain revealed that superfine materials of varying specific gravity can be selectively separated on the condition that a gravity-sensitive filter layer is used and the material has been slightly loosened. Based on the ideas outlined above, a prototype of a carrousel-type jig for the separation of superfine grain was to be designed and built under the subject research project. This separating unit was subsequently to be used for process tests, including especially the separation of superfine pyrite from hard coal and optimization of the process parameters. To begin with, hydromechanical tests were performed with a carrousel section. It turned out that for jigging by the method chosen only a diaphragm equal in area and arranged parallel to the jig screen plate would be suitable as pulsating drive. A concept for the diaphragm configuration was engineered. For lack of funds and innovative impetus, and in view of the reluctant investment policies of the German and international coal mining industries having been unforeseeable at the outset of the project, the latter had to be discontinued in December 1987 despite convincing process fundamentals and technical concepts established so far. (orig.) With 7 refs., 6 figs.

0104 Processing

Refer also to citation(s) 44438, 44442, 45201, 45492, 45709

44415 (CONF-890902–10) **Characterization and upgrading of coal liquids derived from mild gasification processes.** Mrochek, J.E.; Krishnan, R.P.; Graves, R.L. Oak Ridge National Lab., TN (USA). 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. From 198. American Chemical Society national meeting; 10-15 Sep 1989. Order Number DE89012341/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Mild gasification processes produce coal liquids that have the potential to be upgraded for use as transportation fuels. The quality and yield of these liquids vary widely depending upon the severity of the gasification process. Chemical upgrading of coal liquids may offer a viable and potentially economical alternative to conventional hydrotreating processes. Coal liquids from the United Coal Company Research Corporation, the KILnGAS, the SGI International, and Coalite (United Kingdom) processes have been characterized. These liquids and some of their distillates were subjected to solvent extraction upgrading with formic, acetic, and phosphoric acids to remove the basic nitrogenous fraction. Nitrogen removal ranged from about 50 to as high as 98%, with a recovery factor of about 75%. The most cost-effective reagent appears to be 25 vol % phosphoric acid. 10 refs., 4 figs., 1 tab.

44416 (CONF-890902–11) **Combustion characteristics of mild-gasification chars.** Daw, C.S. Oak Ridge National Lab., TN (USA). 1989. 9p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. From 198. American Chemical Society national meeting; 10-15 Sep 1989. Order Number DE89013045/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The commercial success of mild coal gasification (MG) depends on economical utilization of the byproduct char. While various utilization options are being considered (e.g., coke manufacture, activated carbon production, and further gasification), the boiler fuel market is likely to be the largest potential consumer. A key concern is the combustion performance of MG chars relative to more conventional boiler fuels. This paper summarizes recent results of MG char characterizations conducted by Oak Ridge National Laboratory (ORNL) for Morgantown Energy Technology Center (METC) of the Department of Energy (DOE). The char characterizations are being conducted in conjunction with MG liquid characterizations. 13 refs., 3 figs., 4 tabs.

44417 (DOE/MC/21063–2706) **A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized-bed gasification system: Quarterly technical progress report, April to June 1987.** Schmidt, D.K.; Datta, S.; Haldipur, G.B.; Katta, S.; Kettering, E.; Lucas, J.L.; Smith, K.J. KRW Energy Systems, Inc., Madison, PA (USA). Nov 1988. 212p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-84MC21063. Order Number DE89000973/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The external hot gas cleanup system at the PDU was commissioned in July 1986. From July 1986 to April 1987, three tests were completed to develop the zinc ferrite desulfurization process. In this quarter, the in-bed desulfurization system was coupled with the external hot gas cleanup system to study and evaluate PDU performance and the coal gasification and the hot gas cleanup processes while conducting tests with the integrated system. Test Plan TP-037-4 was completed in April 1989 and Test Plan TP-037-5 was initiated in June. During the reporting period, the reactivity of PDU gasifier bed samples (char/limestone or char/dolomite) was determined on the thermogravimetric analyzer. The carbon content of these samples was very low, indicating a high rate of carbon conversion. Test results showed that the gasifier bed samples are very reactive at high carbon conversion levels, thereby showing the effect of sorbent injection on the gasification rate. The effect of various operation parameters on gasifier performance during in-bed desulfurization testing at the PDU was also studied. Performance wa analyzed in terms of gasification rate and product gas composition, using the mechanistic gasifier model. A comparison of the predicted versus the measured is provided herein. Work continued to study and evaluate PDU fines recycle performance. Also included in this report are test data from PDU test TP-037-3. 66 figs., 42 tabs.

44418 (DOE/MC/21063–2707) **A 32-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized-bed gasification system: Quarterly technical progress report, July–September 1987.** Schmidt, D.K.; Datta, S.; Haldipur, G.B.; Katta, S.; Kettering, E.; Lucas, J.L.; Smith, K.J. KRW Energy Systems, Inc., Madison, PA (USA). Nov 1988. 175p. Sponsored by U.S. DOE

Fossil Energy. DOE Contract AC21-84MC21063. Order Number DE89000974/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The external hot gas cleanup system at the PDU was commissioned in July 1986. From July 1986 to September 1987, six tests were completed to develop the zinc ferrite desulfurization process. In this quarter, the integrated coal gasification hot gas cleanup systems at the PDU were operated to complete tests plans TP-037-5 and TP-037-6. An evaluation was completed of all previous external hot gas cleanup tests during the reporting period, and the findings were used to develop a PDU test program to improve external hot gas cleanup system performance in the polishing mode (a product gas velocity <2000 hr^{-1} and an H_2S/COS desulfurizer inlet concentration <600 ppM). A variety of test conditions (from tests TP-037-1 through TP-037-5) were studied. The results showed that the hot gas cleanup potential of zinc ferrite in the PDU has been demonstrated, achieving near equilibrium concentrations of H_2S/COS (<10 ppM) in the product gas exiting the desulfurizer. Six additional laboratory tests were conducted to study tracer gas concentration profiles in a jetting fluidized bed. These data were analyzed along with previous data from the Westinghouse R&D 30-cm unit and the KRW 3-meter Cold Flow Scaleup Facility to obtain dimensionless concentration profiles in a fluidized bed as a function of the jet velocity, the bed density, and the injection location of two materials representing two modes of gasifier operation. These data were input to the PDU mechanistic model to predict gasifier performance. 80 figs., 30 tabs.

44419 (DOE/MC/21063–2708) **A 50-month gasifier mechanistic study and downstream unit process development program for the pressurized ash-agglomerating fluidized-bed gasification system: Annual technical progress report, September 1987–September 1988.** Schmidt, D.K.; Datta, S.; Haldipur, G.B.; Katta, S.; Kettering, E.; Lucas, J.L.; Smith, K.J. KRW Energy Systems, Inc., Madison, PA (USA). Mar 1989. 252p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC21-84MC21063. Order Number DE89000975/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

KRW Energy Systems Inc. has been engaged in a coal gasification and hot gas cleanup technology development program at its pilot plant located at the Waltz Mill Site near Pittsburgh, PA. The coal gasification development program is now considered to be complete, and the primary focus of recent efforts under this contract has been on hot gas cleanup (HGCU). The external hot gas cleanup system at the KRW pilot plant was commissioned in July 1986. Through May 1988, 14 hot gas cleanup tests and 16 external desulfurization cycles were completed to develop a zinc ferrite desulfurization process; included were 953 hours of sulfidation and 623 hours of zinc ferrite regeneration. The external desulfurization tests were integrated with in-bed desulfurization tests conducted in the KRW gasifier-desulfurizer. Fourteen in-bed desulfurization tests were conducted, comprising 700 hours with dolomite injection and 1700 hours with dolomitic limestone injection. From September 30, 1987 through September 30, 1988, the period covered by this report, HGCU test plans TP-037-7, TP-037-8 and TP-037-9 were completed. These tests are discussed in this report. Additionally, a final privately-sponsored test was conducted in July 1988. Following the July test, the pilot plant subsystems were secured and winterized such that the plant will be maintained in a standby condition. 6 refs., 87 figs., 57 tabs.

44420 (DOE/PC/88813–T3) **A solid-state NMR study of condensation/retrograde reactions during coal liquefaction: Quarterly progress report for the period April 1, 1989–June 30, 1989.** Miknis, F.P. Western Research Inst., Laramie, WY (USA). Jul 1989. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-88PC88813. Order Number DE89015995/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this work is to perform an NMR study of the aromaticity in coals, coal derived products and/or model compounds generated by pyrolysis and thermal solubilization of coal in the presence of a hydrogen donor solvent. The study consists of four tasks: (1) develop NMR methods to determine aromatic carbon by CP/MAS and aromatic hydrogen by CRAMPS for low hydrogen containing organic solids such as coals and coal residues; (2) characterize the feasibility of applying the NMR methods for quantitative measurements in coals; (3) analyze selected samples of coals and coal-derived products to demonstrate applicability of the NMR methods to study coal liquefaction, and (4) report the results to the Department of Energy. 7 refs., 2 figs.

44421 (DOE/PC/88920–T3) **Electrochemistry of Thiobacillus ferrooxidans reactions with pyrite: Technical progress report, April 15–August 15, 1989.** Pesic, B.; Oliver, D.J. Idaho Univ., Moscow, ID (USA). 1989. 48p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88920. Order Number DE89015593/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The results presented in the second trimester report (January 15–April 15, 1989) revealed very important phenomena occurring on pyrite surface during fermentation of Thiobacillus ferrooxidans. The events happening on the pyrite surface were evaluated by cyclic voltametry. It was found that the pyrite surface does not change its properties during fermentation until the second day of fermentation. This was concluded by the identical cyclic voltamograms obtained at the beginning of fermentation and after one day of fermentation, which were drastically different from the cyclic voltamograms after two days of fermentation. To verify the reproducibility of results and the importance of the second day of fermentation about five more sets of cyclic voltamograms as a function of fermentation time were produced. This resulted in about 500 experiments and 2 months of continuous experimentation. Also, some errors found in the previous reports were corrected in this report. Each time, it was found that the most drastic pyrite surface property changes happened after two days of fermentation. Thus, the major focus of the future research will be to elucidate the importance of the second day of fermentation and the subsequent phenomena. 16 figs.

44422 (DOE/PC/88942–T2) **Novel supports for coal liquefaction catalysts: Quarterly report No. 3, March 1, 1989–May 31, 1989.** Haynes, H.W. Jr. Wyoming Univ., Laramie, WY (USA). Dept. of Chemical Engineering. 30 Jun 1989. 17p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88942. Order Number DE89015602/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During the last quarter, construction was completed on the Temperature Programmed Desorption/Chemisorption Apparatus, and experiments were conducted with a variety of organic bases to investigate the capabilities of the technique and to identify operating procedures. A comparison of TPD spectra for pyridine and lutidine appears promising as a means of deducing whether acid sites are of the Broensted or Lewis type. A plexiglas mock-up of the miniature liquid fluidized bed proposed in the previous report has produced very encouraging results. Experiments with this device proved essential to the design of a proper impeller and baffle arrangement. 16 refs., 15 figs.

44423 (EGG-M–89052) **A comparison of Uinta Basin, Utah crude oil and biodegraded products.** Hatcher, H.J.; Barrett, K.B.; Taghizadeh, K.; Quigley, D.R.; Meuzelaar, H.L.C. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 12p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC07-76ID01570. (CONF-890902–14: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89016354/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Biodegradation of crude oil is described. Samples of oil shale were collected from Hell's Hole Canyon in Utah, The C-b Tract Mine in Colorado, and the Southman Canyon area in Utah. Tar sands were collected from Asphalt Ridge in Utah. Gilsonite was collected from the Bonanza area of Utah. Petroleum samples were collected from the Red Wash Oil Field and the Altamont-Bluebell Oil Field in Utah. Solid samples were placed in plastic bags and water samples in sterile plastic tubes. The samples were transported to the Idaho National Engineering Laboratory Research Center in Idaho Falls, Idaho for microbiological studies. Samples designated for pyrolysis gas chromatography/mass spectrometry studies were sent to the Center for Micro-Analysis and Reaction Chemistry, University of Utah, Salt Lake City, Utah. 4 refs., 5 figs., 2 tabs.

44424 (ORNL–6562) **Fossil Energy Program semiannual progress report for October 1988 through March 1989.** Judkins,

R.R. Oak Ridge National Lab., TN (USA). Jul 1989. 213p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE89015669/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This report covers progress made during the period October 1, 1988 through March 31, 1989, for research and development projects that contribute to the advancement of various fossil energy technologies. Projects on the Fossil Energy Program are supported by DOE Office of Fossil Energy, DOE Office of Basic Energy Sciences, and the Tennessee Valley Authority. The Fossil Energy Program organization chart is shown in the appendix.

44425 (ORNL/FMP–89/3) **Consolidated bibliography of publications of the DOE Fossil Energy Advanced Research and Technology Development (AR&TD) Materials Program, May 1, 1987–May 31, 1989.** Carlson, P.T. (comp.). Oak Ridge National Lab., TN (USA). Jun 1989. 103p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE89015668/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objective of the AR&TD Materials Program is to conduct research and development on materials for fossil energy applications, with a focus on the longer-term needs for materials with general applicability to the various fossil fuel technologies. The program includes research aimed at better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial improvement in plant operations and reliability. The scope of the Program addresses materials requirements for all fossil energy systems, including materials for coal preparation, coal liquefaction, coal gasification, heat engines and heat recovery, combustion systems, and fuel cells. Work on the Program is conducted at national and government laboratories, universities, and industrial research facilities. The research conducted on the Program is divided among the following research areas: (1) ceramics, (2) new alloys, (3) corrosion and erosion research, and (4) program development and technology transfer. This bibliography of publications of the AR&TD Materials Program covers the period May 1, 1987, through May 31, 1989, and is a supplement to the bibliography covering the period October 1, 1979, through April 30, 1987 (ORNL/FMP-87/3).

44426 (PB–89-195796/XAB) **Importance of active sites for char gasification in oxygen (air) and carbon dioxide. Final report, October 1982-September 1987.** Jenkins, R.G.; Piotrowski, A. Pennsylvania State Univ., University Park, PA (USA). Dept. of Materials Science and Engineering. Mar 1989. 124p. Available from NTIS, PC A06/MF A01.

See also PB–87-173126.

The principal objective of the research program was to study the influence of carbon active sites and catalysis on gasification reactivities of coals and coal chars. Specific emphasis was given to determining the applicability of attempts to measure active-site concentration. Both isothermal and non-isothermal reactivities in air and carbon dioxide clearly indicate that for coals the reactivities decrease as the rank of coal increases. It has shown that for highly disordered chars, reactivity profiles measured by both IR and TGA methods differ for the early stages of burn-off. These differences are a result of surface oxygen complexes. Oxygen-chemisorption kinetics on selected samples in the absence of gasification have shown that chemisorption essentially occurs on highly active carbon sites. For calcium-loaded samples, the amount of oxygen chemisorbed at the same temperature is almost four times higher than that for 'pure' carbon, which indicates that the oxygen spillover from calcium onto carbon occurs. Additionally, it has been shown that the carbon active sites are energetically heterogeneous. Because of this heterogeneity, normalization of reactivity based upon a simple active surface area measured as a total stable oxygen complex was unsuccessful.

44427 (SAND–89-0853C) **Studies of the initial reactions that occur during direct coal liquefaction.** Stohl, F.V. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC04-76DP00789. (CONF-890902–8: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89011542/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Reactions that occur during preconversion processing of coal in direct liquefaction can be either beneficial or harmful. The objectives of this work are to identify the types of compounds and process conditions that give rise to retrogressive reactions during preconversion processing. Experiments have been performed to evaluate the impacts of temperature, catalysts, mineral matter, and hydrogen donors on these reactions. Initial studies have been carried out using dibenzyl ether (DBE) because ether linkages represent one type of bonding believed to be present in coal (1). Previous studies have analyzed the kinetics and mechanisms of thermolysis of DBE (2,3) and have also used DBE to study effects of process variables in coal liquefaction (4). Results of thermal reactions with DBE have shown that the main reaction products are toluene, benzaldehyde, benzyl alcohol and benzene (2). In the presence of catalysts such as $ZnCl_2$, the product distributions are more complicated and can obtain significant amounts of material with higher molecular weights than DBE (5,6). 8 refs., 2 tabs.

44428 (SAND–89-0883C) **Activation of hydrous titanium oxide-supported catalysts for HYD [hydrogenation], HDS [hydrodesulfurization], and HDO [hydrodeoxygenation] reactions.** Dosch, R.G.; Stohl, F.V.; Richardson, J.T. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC04-76DP00789. (CONF-8909129–1: Fuel Division national meeting, 10-15 Sep 1989). Order Number DE89011841/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Hydrous titanium metal oxide catalysts are extremely versatile materials that have promise as coal liquefaction catalysts. Previous studies have shown that they perform well in both batch and bench-scale coal liquefaction tests. Efforts to improve preparation and activation procedures for these catalysts have identified several promising research areas that either have or may lead to enhancements in catalyst activity. For example, addition of Si to the support of NiMo HTO catalysts has yielded 2- to 3-fold increases in surface areas and has resulted in a 33% increase in hydrogenation activity and a doubling of hydrodeoxygenation activity compared to an HTO catalyst without Si. In addition, it may be possible to maintain the high atomic dispersion of the metals at reaction conditions by calcining prior to ion exchange of the metal onto the support or reducing the calcination temperature. 6 refs., 4 figs., 1 tab.

44429 (SAND–89-1216C) **Influence of organic coal structure on liquefaction behavior under low-severity conditions.** Snape, C.E.; Derbyshire, F.J.; Stephens, H.P.; Kottenstette, R.J.; Smith, N.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 17p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-83PC60811;AC04-76DP00789. (CONF-890902–9: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89013587/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The influence of coal structure on primary conversions and oil yields in thermolytic extraction with different H-donor and non-H-donor solvents and in dry catalytic hydrogenation has been investigated. Pre-soaking of coal/H-donor solvent slurries at 250°C increased conversions and the level of hydrogen transfer at short contact times (SCT, $\leq$ 10 min) with 9,10-dihydrophenanthrene demonstrating the importance of solvent accessibility. However, contrary to other studies, prior removal of THF-extractable material (mobile phase) from one bituminous coal actually gave rise to higher conversions to pyridine - solubles for non-donor polynuclear aromatic compounds (PAC), such as naphthalene, phenanthrene and pyrene. These findings highlight the difficulties in relating primary conversions to coal characteristics. In contrast, oil yields have been found to broadly increase with decreasing rank on both H-donor solvent extraction with a process solvent and dry catalytic hydrogenation. However, in SCT tetralin extraction where poor physical contact between coal and solvent exists, neither total conversion nor oil yield correlated with rank. 27 refs., 6 figs., 4 tabs.

44430 (SAND–89-7072C) **Development of a methodology for a comparative techno-economic analysis of coal liquefaction, coprocessing and resid upgrading.** Gray, D.; Tomlinson, G.C.; Elsawy, A. Sandia National Labs., Albuquerque, NM (USA). 1989. 11p. Sponsored by U.S. DOE Fossil Energy. DOE Contract

AC04-76DP00789. (CONF-890916–1: 6. annual international Pittsburgh coal conference, 25-29 Sep 1989). Order Number DE89015410/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper provides an outline of the methodology that has been developed to allow a comparative technical and economic analysis of coal liquefaction using the HRI CTSL process, coprocessing using the HRI technology, and resid upgrading using the H-OIL process. These three similar technologies have been evaluated on as comparable a basis as possible so that their relative technical and economic merits can be identified. The approach used to perform this analysis also allows sensitivity analyses to be performed with respect to feedstock costs and other significant parameters so that the conditions for economic utilization of coprocessing can be identified. 9 refs., 4 figs., 2 tabs.

0106 Properties

Refer also to citation(s) 44409, 44415, 44420, 44424, 44429, 44449, 44623, 45594

44431 (CONF-890902–3) **Coal thermolysis modeling: The effects of restricted diffusion on thermal reaction pathways.** Buchanan, A.C. III; Britt, P.F.; Biggs, C.A. Oak Ridge National Lab., TN (USA). [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 198. American Chemical Society national meeting; 10-15 Sep 1989. Order Number DE89011229/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The technique of model compound immobilization by covalent surface attachment is being employed to investigate the potential impact of restricted diffusional mobility on the thermal reactivity of coal. This restricted mobility may be imposed in coal as a consequence of its cross-linked, macromolecular structure. A detailed study of the thermolysis of surface-immobilized bibenzyl showed that the rate of unimolecular C-C homolysis is similar to that in fluid phases. Recent studies have foucused on the thermally induced, free radical chain decomposition reactions for surface-immobilized 1,3-diphenylpropane and 1,4-diphenylbutane. For 1,4-diphenylbutane both the reaction rate and product composition are strongly dependent on surface coverage and, hence, the proximity of 1.4-diphenylbutane molecules and hydrogen abstracting radicals on the surface. The rates and selectivities of these key bimolecular reaction steps on the surface might also be affected by the structure of neighboring molecules. In the current study, we are beginning to probe this feature by examining the influence of the structure of co-attached aromatic molecules such as biphenyl and diphenylmethane on the reaction rate and regioselectivity in the thermolysis of 1,4-diphenylbutane. 7 refs. , 1 fig., 2 tabs.

44432 (CONF-890902–13) **Swelling of coal extracts.** Green, T.K.; Chamberlin, J.M.; Lopez-Froedge, L.; Ball, J.E. Western Kentucky Univ., Bowling Green, KY (USA). Dept. of Chemistry. 1989. 24p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88924. From 198. American Chemical Society national meeting; 10-15 Sep 1989. Order Number DE89016645/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

There has been a rapid growth in research that deals with the solvent swelling of coal. Much of this effort has been directed toward the application of modern polymer and network theories to coal, with the purpose of better understanding their network structures. One of the most fundamental parameters of a network structure is the average molecular weight between crosslinks. Several research groups have attempted to estimate this for coal from solvent swelling data and the Flory-Rehner equation. The equation incorporates both the Flory-Huggins theory of polymer solutions and the Gaussian elastic network theory. An important parameter embodied in the Flory-Huggins theory is the interaction parameter, χ. χ is a thermodynamic parameter describing the energetics of the polymer-solvent interaction. Very few reliable methods have been developed to evaluate χ for coal-solvent systems. It is the purpose of this research to develop a reliable method for its evaluation. The solvent swelling of coal extracts; utilizing benzene as the solvent, is discussed. 9 figs., 6 tabs.

44433 (DOE/PC/79925–6) **Chemical characterization of the surface sites of coal: Progress report, December 15, 1988–March 14, 1989.** Fowkes, F.M.; Riddle, F.L. Jr.; Cole, D.A. Lehigh Univ., Bethlehem, PA (USA). Dept. of Chemistry. Jul 1989. 24p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87PC79925. Order Number DE89015592/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In our last report we described a method for evaluating the NMR chemical shift of acid-base complexes. Since the complexes are formed under equilibrium conditions and the rate of exchange between the free and complexed states of the probe molecule is fast compared to the NMR observation time, the observed chemical shift is a weighted average of the shifts corresponding to these two states. The last report presented data for the acid-base adduct formation of triethylphosphine oxide with several acids in CCl_4 solutions. We have extended this work to include the same system, however now using isooctane as the solvent. We also present our findings for the complexation of tricyclohexylphosphine sulfide with several acids using CCl_4 and isooctane as solvents. The phosphine oxide and sulfide compounds are hard and soft bases respectively and will be used to measure the surface acidity of coal in the near future. Preliminary results are also given for the adducts formed between diphenyl mercury and several basic molecules in CCl_4 solutions. 3 refs., 8 figs., 9 tabs.

44434 (DOE/PC/80535–T3-Pt.1) **Hydrogen bonding in coal liquids and coal liquid distillates: Final report for the study period, October 1985–May 1989.** Lewis, E.A.; Hansen, L.D.; Eatough, D.J. Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry. 1989. 376p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80535. Order Number DE89015604/JAW. Available from NTIS, PC A17/MF A01 - OSTI.

The research performed in this project will be used in the development of analytical techniques for the determination of the compounds involved in hydrogen bonding, of the extent of hydrogen bonding, and of the thermodynamics associated with the hydrogen bonding interactions in coal liquids. Data collected will be used to develop models for the prediction of both the thermodynamic and physical properties of coal liquid based on easily measured properties. Specific objectives include: (1) development of calorimetric techniques for the analytical determination of: (a) the concentrations of coal liquid acids (including phenols and carboxylic acids) and coal liquid bases (including anilines, pyridines, and amines), and (b) the fractions of these polar compounds that are (1) unassociated, (2) self-associated, or (3) associated with other compounds; (2) determination of the extent of hydrogen bonding in neat coal liquids and distillate cuts; (3) development of models for the prediction of thermodynamic and physical properties of coal liquids and distillate cuts. To date, we have developed potential analytical methods for: (1) the determination of total N-bases in coal liquids by direct titration with a strong acid titrant (TCA), (2) the identification of classes of both the acid and base compounds in coal liquids using an extraction/calorimetric titration procedure (60% methanol/40% H_2O). We have also been able to show that the compounds identified are those that must be determined in order to predict the thermodynamic and thermophysical properties of coal liquids. Experimental data are appended. 18 refs.

44435 (DOE/PC/80535–T3-Pt.2) **Hydrogen bonding in coal liquids and coal liquid distillates: Final report for the study period, October 1985–May 1989: Part 2.** Lewis, E.A.; Hansen, L.D.; Eatough, D.J. Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry. 1989. 327p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80535. Order Number DE89015605/JAW. Available from NTIS, PC A15/MF A01 - OSTI.

The research performed in this project will be used in the development of analytical techniques for the determination of the compounds involved in hydrogen bonding, of the extent of hydrogen bonding, and of the thermodynamics associated with the hydrogen bonding interactions in coal liquids. Data collected will be further used to develop models for the prediction of both the thermodynamic and physical properties of coal liquid based on easily measured properties. Specific objectives include: (1) development of calorimetric techniques for the analytical determination of: (a) the concentrations of coal liquid acids (including phenols and carboxylic

acids) and coal liquid bases (including anilines, pyridines, and amines), and (b) the fractions of these polar compounds that are (1) unassociated, (2) self-associated, or (3) associated with other compounds, (2) determination of the extent of hydrogen bonding in neat coal liquids and distillate cuts, (3) development of models for the prediction of thermodynamic and physical properties of coal liquids and distillate cuts. This report contains data on aqueous HCl extractions of the T102-T8 coal liquid. (CBS)

44436 (DOE/PC/80535–T3-Pt.3) **Hydrogen bonding in coal liquids and coal liquid distillates: Final report for the study period, October 1985–May 1989.** Lewis, E.A.; Hansen, L.D.; Eatough, D.J. Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry. 1989. 331p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80535. Order Number DE89015606/JAW. Available from NTIS, PC A15/MF A01 - OSTI.

The research performed in this project will be used in the development of analytical techniques for the determination of the compounds involved in hydrogen bonding, of the extent of hydrogen bonding, and of the thermodynamics associated with the hydrogen bonding interactions in coal liquids. Data collected will be further used to develop models for the prediction of both the thermodynamic and physical properties of coal liquid based on easily measured properties. Specific objectives include: (1) development of calorimetric techniques for the analytical determination of: (a) the concentrations of coal liquid acids (including phenols and carboxylic acids) and coal liquid bases (including anilines, pyridines, and amines), and (b) the fractions of these polar compounds that are (1) unassociated, (2) self-associated, or (3) associated with other compounds; (2) determination of the extent of hydrogen bonding in neat coal liquids and distillate cuts; (3) development of models for the prediction of thermodynamic and physical properties of coal liquids and distillate cuts. This report contains data on aqueous HCl extractions of the T102-T8 coal liquid.

44437 (DOE/PC/80535–T3-Pt.4) **Hydrogen bonding in coal liquids and coal liquid distillates: Final report for the study period, October 1985–May 1989: Part 4.** Lewis, E.A.; Hansen, L.D.; Eatough, D.J. Brigham Young Univ., Provo, UT (USA). Dept. of Chemistry. 1989. 315p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-85PC80535. Order Number DE89015607/JAW. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

Research performed in this project will be used in the development of analytical techniques for the determination of the compounds involved in hydrogen bonding, of the extent of hydrogen bonding, and of the thermodynamics associated with the hydrogen bonding interactions in coal liquids. Data collected will be further used to develop models for the prediction of both the thermodynamic and physical properties of coal liquid based on easily measured properties. Specific objectives include: 1. Development of calorimetric techniques for the analytical determination of: (a) the concentrations of coal liquid acids (including phenols and carboxylic acids) and coal liquid bases (including aniline, pyridines, and amines), and (b) the fractions of these polar compounds that are (1) unassociated, (2) self-associated, or (3) associated with other compounds, 2. Determination of the extent of hydrogen bonding in near coal liquids and distillate cuts, 3. Development of models for the prediction of thermodynamic and physical properties of coal liquids and distillate cuts. This report contains data on aqueous NaOH extractions of the T102-T8 coal liquid.

44438 (EPRI-ER–6488) **Fundamental chemical structure of coal: Final report.** Chung, K.E. Electric Power Research Inst., Palo Alto, CA (USA); Rockwell International Corp., Thousand Oaks, CA (USA). c Aug 1989. 47p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

An Illinois bituminous coal was characterized in terms of the distribution and arrangement of aromatic clusters, oxygen functional groups and linkages. The characterization consisted of controlled solubilization of the coal, solvent fractionation of the soluble product and detailed analyses of the product fractions. The coal was solubilized in reactions with NaOH/ethanol/H_2O at temperatures, 215–320°C. Elemental balance and spectroscopic data revealed that oxygen functional groups of the coal reacted selectively, resulting in a gradual "depolymerization" of the complex coal structure. The role of the solubilization reaction was examined by using model compounds. Using the structural data, a molecular model of the coal was constructed, and its hydroliquefaction behavior was predicted in terms of potential products, their distribution, and hydrogen requirement for the cleavage of aliphatic linkages. 9 refs., 22 figs., 13 tabs.

44439 (SAND–89-0725C) **Modeling of coal structure using computer-aided molecular design.** Carlson, G.A.; Granoff, B. Sandia National Labs., Albuquerque, NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890902–4: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89011511/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Knowledge of coal molecular structure is important in the understanding of coal reactivity. Computer-aided Molecular Design (CAMD) has been used to create and study 3-dimensional models of several postulated coal structures. Using molecular dynamics calculations, a minimum-energy conformation for each structural model has been determined. Characteristics of the resulting coal structures will be discussed. Interactions of the structures with polar and nonpolar solvent molecules are being explored to provide insight into coal pre-conversion chemistry. Future studies possible with this new tool will be outlined. 9 refs., 2 figs., 1 tab.

44440 **Fly ash and silica fume chemistry and hydration.** Roy, D.M. (Pennsylvania State University, University Park (USA). Materials Research Laboratory). vp. of Concrete 88 workshop - supplementary papers. Ryan, W.G. (ed.) British Library Document Supply Centre, Boston Spa, UK (Jul 1988). (CONF-8807183–:).

The hydration of cements containing the supplementary cementing materials fly ash (FA) and silica fume (SF) is discussed and compared with the hydration of ordinary portland cement (OPC). Early stage heats of hydration, changes in the chemistry of the solution (both at early stages, and later pore solution compositions), microstructural development, and pore structure are compared. The hydration rates normally follow the order: SF>OPC>FA. The complex hydration processes may be controlled so that the use of these cements enables development of materials having superior strength and durability. 43 refs., 8 figs., 4 tabs.

44441 **Mathematical models of temperature programmed desorption of oxygen complexes from porous chars and carbons.** Calo, J.M. (Brown Univ., Providence, RI (USA)); Hall, P.J. *Preprints of Papers, American Chemical Society, Division of Fuel Chemistry (USA),* 34(1): 71-78 (1989). (CONF-8904169–: Symposium on the fundamentals of gasification, 9-14 Apr 1989).

It is shown that a numerical model of the TPD behavior of surface oxygen complexes is a very useful tool for aiding in the interpretation of experimental TPD data. The fact that secondary reaction via (R.1) contributes significantly to the spectra, in terms of CO_2 reflection peaks and diminution of the primary CO peak, shows that it becomes a very important consideration under the appropriate conditions. The fact that the degree of secondary reaction has been found to be very sensitive to the kinetic parameters, energetic heterogeneity via the activation energy variation with surface coverage, and the diffusion time may help explain the significant quantitative variations in TPD spectra obtained by different workers on various chars and carbons. In fact, it may be possible to develop the sensitivity of secondary reaction to intrapore diffusivity into a technique for measuring transport rates. Diffusional resistances of the order-of-magnitude examined here do not seem to contribute appreciably to tailing and broadening of the primary desorption peaks; surface heterogeneity seems to be primarily responsible for the latter. This result will be used to obtain a measure of the energetic heterogeneity of coal chars under varying conditions. The model will be the primary tool in this regard. Recently, the authors have also begun to incorporate CO re-adsorption onto high-energy sites during the course of TPD, in order to model the high temperature shoulder, which, under certain circumstances, they have observed develop into a separate CO peak, the appearance of which varies considerably depending on various conditions. This mechanism represents another secondary interaction effect with the char surface that occurs during TPD that must be taken into account in order to properly deconvolute TPD spectra of oxygen complexes from coal chars.

44442 Role of free radicals in hydroprocessing of coal liquids. Wandke, H.H. (Oklahoma State Univ., Stillwater (USA)); Mahorankit, W.; Seapan, M. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA)*, 33(3): 413-419 (Aug 1988). (CONF-8809265--: Chemistry of carbonization of petroleum feedstocks, 25-30 Sep 1988).

Carbonization of liquid fossil fuels at hydroprocessing temperatures of around 350°C manifests itself as coking of catalysts and fouling of processing equipment. Catalyst coking is believed to be at least partly due to free radical reactions which cause condensation and polymerization of small molecules. An earlier study on hydrogenation of model compounds indicated that addition of an organometallic compound, bis (cyclopentadieny) titanium (IV) dichloride known as titanocene dichloride to the feed affected the coke formation probably by changing the mechanisms of free radical reactions (Tescheikuna and Seapan 1985). Therefore, in this project we conducted a study, using an SRC-II middle distillate and an SRC-II process solvent, to evaluate the role of free radicals and titanocene dichloride in hydrotreatment processes.

0108 Waste Management

Refer also to citation(s) 44417, 44419, 44440, 44998, 45399

44443 (DOE/PC/88927–T3) **Mechanistic and kinetic studies of high-temperature coal gas desulfurization sorbents: Quarterly technical progress report No. 4, April–June 1989.** Lew, S.; Flytzani-Stephanopoulos, M.; Sarofim, A.F. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Chemistry. Jul 1989. 23p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88927. Order Number DE89015590/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A much more detailed study was performed during this quarter of the reactions involved in the reduction of ZnO-TiO_2 sorbents which were briefly discussed in our first quarterly report. As before, the findings pertaining to ZnO-TiO_2 systems will be compared with the reduction of ZnO under similar experimental conditions. The objectives of this study were to investigate the mechanisms and kinetics of sorbent ZnO-TiO_2 as a function of the following parameters: (1) Zn/Ti sorbent ratio; (2) reduction temperature; (3) H_2 concentration. 18 refs., 10 figs., 2 tabs.

44444 (EPRI-GS–6481) **Ash utilization in highways: Delaware demonstration project.** Srivastava, L. Electric Power Research Inst., Palo Alto, CA (USA); Delmarva Power and Light Co., Wilmington, DE (USA). c Aug 1989. 209p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report documents the design, preconstruction laboratory testing, construction and performance monitoring of a fly ash embankment constructed within a new interchange for an Interstate highway in Delaware. Data presented in this interim report indicates that fly ash fill is comparable to granular borrow material from an engineering standpoint, and that the preliminary groundwater quality monitoring results have indicated no adverse impact on water quality. In this project, fly ash was used for the construction of two of the six new interchange ramps in the Interstate 495 project connecting Edgemoor Road with the highway northeast of Wilmington, Delaware. These ramps were constructed during June 1987. This report presents the details of the preconstruction testing, construction and interim groundwater monitoring activities. Approximately 8000 tons of fly ash were delivered to the project site from moisture controlled stockpiles. All fly ash was able to meet or exceed DEL DOT compaction requirements. At no time during the construction of the fly ash fill was there any problems with dusting. Four groundwater monitoring wells were installed in the vicinity of the site in January 1987, and quarterly samples obtained and analyzed to determine effects on groundwater quality. This interim monitoring data confirms that fly ash is an environmentally acceptable alternative to natural soil when used in a highway embankment. 13 refs., 62 figs., 30 tabs.

44445 (PB–89-200810/XAB) **Bench-scale studies to identify process parameters controlling reburning with pulverized coal. Final report, January 1980-December 1983.** Pershing, D.W.; Heap, M.P.; Seeker, W.R. Energy and Environmental Research Corp., Irvine, CA (USA). May 1989. 182p. Available from NTIS, PC A09/MF A01.

This report addresses the evaluation of a technology which is a combination of two technologies used to control the atmospheric emission of NOx by stationary sources: combustion modification, which controls flame temperature and maximizes fuel-rich residence time to minimize NOx formation and flue-gas cleaning, which uses a reducing agent with or without a catalyst to remove NOx from combustion products. The combined technology uses fuel as a reducing agent to remove NOx. The process, referred to as in-furnace NOx reduction, reburning, and staged fuel injection, can be applied to many types of combustion systems. In fact, reburning is the process which allows the 'in-furnace NOx reduction' to take place. Reburning involves two processes: NO reduction, in which reburning fuel is added to the combustion products of the main combustion zone, which operates fuel lean, to produce a fuel-rich mixture, products of which are referred to as total fixed nitrogen, and TFN oxidation, in which air is added to produce overall fuel-lean conditions, with the NH_3, HCN, NO, and char nitrogen converted to either N_2 or NO and fuel oxidation completed.

0109 Environmental Aspects

Refer also to citation(s) 44424, 44866, 45196, 46070

44446 (JY/YTK-TIED–129) **Peat dust deposition in the neighbourhood of peat mining areas.** Ilola, M.; Niskanen, I.; Veijola, H. Jyvaeskylae Univ. (Finland). Inst. for Environmental Research. 1989. 72p. (In Finnish). Order Number DE89787751/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Peat dust deposition was studied in the neighbourhood of four peat mining areas in Central and Eastern Finland during the summers of 1987 and 1988, total and organic deposition being measured with deposiion gauges. Emissions were largely influenced by the stage of humification of the harvested peat and the harvesting technique used, being highest in areas where highly humified peat was harvested by a pneumatic harvesting technique. Total deposition averaged 10-13 g/m^2/month on the edges of areas of this kind, but was only 2-3.5 g/m^2/month at a distance of 400-500 m from the edges of these areas. Deposition was lowest in areas where the pea was of low humification and was harvested by a mechanical method, total deposition being only 1.5 g/m^2/month on average on the edge of such areas. The background deposition in the area was about 1 g/m^2/month. The pneumatic harvesting technique used in humified peat fields increased organic deposition at a distance of several kilometres from the source, whereas with the mechanical harvesting method the deposition was mainly restricted to the edges of the peat mining areas. The weather conditions greatly affected the spread of the peat dust, in that deposition was much lower during the wet summer of 1987 than in 1988, when the summer was dry and warm. The dry peat dust forms a visible film on water and in this way reduces the recreational value of the lakes and rivers.

0120 Mining

Refer also to citation(s) 44446

44447 (PB–89-201453/XAB) **Calamity Hollow Mine Fire Project. (In five parts). 2: Operation of the burnout control system. Report of investigations/1989.** Chaiken, R.F.; Dalverny, L.E.; Kim, A.G. Bureau of Mines, Pittsburgh, PA (USA). 1989. 43p. (BUMINES-RI–9241). Available from NTIS, PC A03/MF A01.

Library of Congress catalog card no. 83-60025. See also PB–83-225417.

During the period from Janurary to May 1982, the U.S. Bureau of Mines carried out a continuous field test of the Burnout Control process for controlling abandoned mined-land fires. In this process, the rate of burning of an underground mine fire is accelerated through the action of a suction fan, which pulls and collects hot combustion gases from the mine while causing air to flow over the fire. Burnout Control thus controls the emission of heat and fumes from the mine fire, and produces sufficient thermal power to run a small electrical generation plant. Previous reports in the five-part series have described the design, construction, and instrumentation of the Burnout

Control system at Calamity Hollow, Allegheny County, PA, and the quenching and excavation process by which the fire was cooled and finally extinguished after this particular experimental field test. The report, which completes the full description of the Calamity Hollow Coal Mine Fire Project, summarizes in detail various aspects of the operational phase of the field test. It includes a chronology of events, a discussion of the technical data, and a summary of results. Despite mechanical and operational problems, the field trial at Calamity Hollow demonstrated that Burnout Control is a viable method of controlling an abandoned mine fire.

44448 (STEV-TORV–89-6) **Ryholm's peat.** Matsson, R.; Wilde, J. Statens Energiverk, Stockholm (Sweden); Swedish State Power Board, Vaellingby (Sweden). 17 Feb 1989. 110p. (In Swedish). (SV-UL–1989-18). Order Number DE89914797/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The purpose was to develop a system for production of dry peat fuel year around. An essential part in the system was to be the fluidized bed dryer developed by ABB STAL. Between the autumn of 1984 until the summer of 1985 the first stage of the project was carried out. In this period Haegglund's developed a system for deep excavating of peat year around while the Swedish State Power Board tested press-systems for mechanical dewatering of peat. At ABB STAL the development work on the fluidized bed dryer continued. In July 1985 a company, Ryholm Torv HB, was to start, own and run a production factory at Ryholm Stormosse. The peat fuel was to be used by the township of Joenkoeping at their combustion plant at Munksjoe to replace coal. In a first stage a prototype plant was built at the peat bog to test the production system. The plant was finished in October 1986 and a test run carried out until November 1987. The result of the test run can shortly be summarized so that the process served well but the obtained performance characteristics are poorer than expected. The economic prerequisities had been deteriorated by higher production costs and a lower market price for the product. In April 1988, the company board decided to shut down the project. (authors).

0130 Transport and Handling

Refer also to citation(s) 45232

44449 (CONF-8909178–1) **Development and characterization of transparent slurries for basic and applied research in solids transport.** Mannheimer, R.J.; Park, J.T.; Grimley, T.A.; Morrow, T.B. Southwest Research Inst., San Antonio, TX (USA). [1989]. 23p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-86PC90962. From US-Korea joint seminar on fluids engineering and science; 3-9 Sep 1989. Order Number DE89016320/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses some of the problems associated with refractive index matching of solids to produce transparent slurries that have rheological properties (including wall-slip and a yield value) similar to commercially important slurries. The recent development of these transparent slurries has made it possible to use laser Doppler velocimetry (LDV) to characterize the velocity profiles and rms components of velocity of non-Newtonian slurries in laminar, transitional, and turbulent flows. Rheological properties of the transparent slurries, measured with a concentric cylinder viscometer, are compared to rheological properties determined from pressure gradients and flow rates in large-scale pipe flow. LDV measurements of the laminar and turbulent velocity profiles will also be discussed. 15 figs.

0140 Combustion

Refer also to citation(s) 44416, 44425, 44445, 44971, 44999, 45201, 45876

44450 (DOE/PC/79901–T4) **Radiative properties of ash and slag: Seventh quarterly report, February 1, 1989–June 30, 1989.** Solomon, P.R.; Markham, J.R. Advanced Fuel Research, Inc., East Hartford, CT (USA). Jul 1989. 96p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC79901. Order Number DE89015998/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Thermal radiation plays a key role in the operation and efficiency of combustion systems, accounting for over 90% of the heat transfer. The analysis of radiative heat transfer in coal-fired boilers, combustion chambers and other energy systems requires accounting for the effects of inorganic deposits on bounding surfaces and of entrained particulates, such as pulverized coal, char, and fly-ash. These effects can be predicted; however, the accuracy in predicting the radiative properties of entrained pyrolysis (ash) and deposit layers (slag) is limited by inaccurate knowledge of the physical/chemical properties of the materials over a range of material temperatures and radiative wavelengths that is representative of conditions in practical combustion systems. The objective of this project is to make laboratory measurements of the radiative properties of extracted ash deposit samples. During this quarter, technique validation measurements were completed and measurements were performed on slag supplied by the Babcock and Wilcox Company. 11 refs., 56 figs., 2 tabs.

44451 (DOE/PC/88937–T4) **Experimental studies on group ignition of a cloud of coal particles: Quarterly progress report No. 3, March 16, 1989–May 15, 1989.** Annamalai, K. Texas A and M Univ., College Station, TX (USA). Dept. of Mechanical Engineering. 28 Jun 1989. 10p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-88PC88937. Order Number DE89015996/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Progress continued on ignition of coal particles. The objectives for the current quarter were: Install the modified test rig with narrow slit like quartz windows and purge the system. Connect the newly developed locally fluidized feeder (LFF) system, and obtain preliminary experimental data on ignition. At this stage of the project the laminar flow reactor is completely assembled and connected to the control panel. The locally fluidized feeder has been connected to the rig and some preliminary test runs have been conducted. Preliminary data on ignition are still to be obtained since other tests have been performed prior to the coal ignition tests. 4 figs.

44452 (EPRI-CS–5936-SR, pp. 1.63-1.80) **Correlation of slagging/fouling from utility operating data.** Barrett, R.E. (Battelle Columbus Div., OH (USA)); Tuckfield, R.C. Electric Power Research Inst., Palo Alto, CA (USA). Sep 1988. (CONF-871050–: Effects of coal quality on power plants, 13-15 Oct 1987). In *Effect of coal quality on power plants: Proceedings.* Order Number DE88016609/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A survey was conducted among utilities to collect data on boiler features, coals fired, operating parameters and the frequency and nature of slagging and fouling problems. The collected data were then analyzed to identify coal boiler and operating parameters that correlated with utility slagging and fouling experience. It was found that using coal parameters alone enabled most of the units to be classified into frequent and infrequent slagging or fouling categories. Coal parameters alone gave a 71 to 87% classification for the various coal deposit problem cases. However, most of the coal parameters that gave the best classifications were not those commonly used for assessing the slagging and fouling tendencies of coals. When boiler terms were included, the classification of units by the frequency of their deposit problems increased to 86 to 96%. The average percentage of units misclassified was more than cut in half - it was reduced from 21 to 10% of the units surveyed. The most marked improvement was for the bituminous ash coal-slagging case; including a boiler parameter improved the classification from 71 to 91%. Operating parameters were found to not improve the classification of units by the frequency of their deposit problems. Equations and graphics are used to present the relationships that provide the best classifications of units.

44453 (EPRI-CS–5936-SR, pp. 1.81-1.101) **Interpretation and use of empirical slagging criteria.** Anson, D. (Battelle Columbus Div., OH (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Sep 1988. (CONF-871050–: Effects of coal quality on power plants, 13-15 Oct 1987). In *Effect of coal quality on power plants: Proceedings.* Order Number DE88016609/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

After a review of laboratory methods of sample preparation for coal ash characterization, slagging criteria based upon fusion behavior or slag rheology are discussed. Terms such as softening

temperature, hemisphere temperature, and fluid temperature are explained. Boiler characteristics and operational factors related to slagging behavior are also discussed.

44454 (EPRI-CS–5936-SR, pp. 2.55-2.74) **Techniques to reduce fireside corrosion and fly ash erosion.** Wright, I.G. (Battelle Columbus Div., OH (USA)); Williams, D.N.; Mehta, A.K. Electric Power Research Inst., Palo Alto, CA (USA). Sep 1988. (CONF-871050–: Effects of coal quality on power plants, 13-15 Oct 1987). In *Effect of coal quality on power plants: Proceedings.* Order Number DE88016609/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Fireside corrosion and fly ash erosion are responsible for a significant fraction of boiler tube failures, and utilities have used varying techniques to remedy such problems. In a recent review of the state of the art on methods of reducing the importance of fireside corrosion and fly ash erosion as factors responsible for tube failures in utility boilers, the causes of these problems were examined and the remedial measures practiced or available were reviewed. It was found that fireside corrosion and fly ash erosion are considered to be major problems only at those units burning coal that is rated as very aggressive (high sulfur, alkalis, and chlorine) or that contains a high percentage of erosive minerals such as quartz in the ash. Fly ash erosion of primary superheater, reheater tubes and of economizer tubes in the back pass is presently a more serious problem than fireside corrosion. These problems are being effectively managed by extensive maintenance and the use of sacrificial, temporary measures such as pad welding and the fitting of tube shields. Although there are available proven permanent solutions for most of the problems encountered, these are not widely applied because the costs of installation are perceived to compare unfavorably with continued maintenance activities, even though several forced outages annually are still caused by fireside corrosion and fly ash erosion. Some of these techniques, and their relative merits, are discussed below.

44455 (EPRI-CS–5936-SR, pp. 3.53-3.63) **The fate of coal ash: The effect of coal combustion mechanism.** Beer, J.M. (Massachusetts Institute of Technology, Cambridge (USA)); Sarofim, A.F. Electric Power Research Inst., Palo Alto, CA (USA). Sep 1988. (CONF-871050–: Effects of coal quality on power plants, 13-15 Oct 1987). In *Effect of coal quality on power plants: Proceedings.* Order Number DE88016609/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Agglomeration during the heating up of a cloud of pulverized coal particles to ignition, deagglomeration during devolatilization and fragmentation during char oxidation which affect sensitively the fly ash particle size distribution and hence deposit formation of ash in boiler plant are discussed. It is argued that a better understanding of the coal combustion mechanism combined with that of the transformation of the mineral matter in the combustion process is necessary to predict the deposition characteristics of coal ash. A qualitative and, in part, quantitative assessment of the pertinent parameters that influence fly ash size distribution is presented. It appears that strongly macroporous chars and high rates of initial heating of the coal particle are beneficial for producing a fine fly ash particle size.

44456 (EPRI-CS–5936-SR, pp. 3.65-3.79) **The fate of mineral matter during pulverized coal combustion.** Hardesty, D.R. (Sandia National Labs., Livermore, CA (USA)); Nissen, D.A. Electric Power Research Inst., Palo Alto, CA (USA). Sep 1988. (CONF-871050–: Effects of coal quality on power plants, 13-15 Oct 1987). In *Effect of coal quality on power plants: Proceedings.* Order Number DE88016609/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Traditionally, the analysis of mineral matter in coal has involved destruction of the maceral matrix and determination of the mineral content by X-ray diffraction or wet chemical methods. The result is the gross chemical composition of the coal sample. While these data may be useful for some applications, a great deal of valuable information is irretrievably lost when these methods are employed. What is required is the actual size distribution and composition of the mineral particles in raw coal as well as the subsequent char. But because of its heterogeneous nature, meaningful mineral analyses of coal can only be done by analyzing large numbers of particles. These data can be acquired by utilizing the automated scanning capability of the electron microscope coupled with analysis of characteristic X-rays emitted by mineral particles. At the Sandia Livermore Combustion Research Facility the authors are conducting a comprehensive fundamental investigation of the devolatilization of pulverized coals and the subsequent oxidation of the residual chars. Of particular interest is ultimately relating the behavior of the inorganic constituents to the evolution of the morphology of the organic matrix during combustion, and to the measured rates of devolatilization and char oxidation. In this paper the most recent work on the fate of mineral matter during the controlled combustion of pulverized coal samples is reviewed.

44457 (GB–197) **Harwell coal combustion programme. Second annual report on a research programme funded by The Department of Energy.** Sykes, J. UKAEA Harwell Lab. (UK). Engineering Science Div. Mar 1989. 19p. Order Number DE89916360/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The first programme on the Measurements and Scaling of industrial coal flames covers measurements - to obtain detailed experimental data using laser techniques about the structure and processes occurring in industrial coal flames. modelling, instrumentation - to develop and apply a new laser technique PAMS for measuring concentrations of some of the chemical species important in pollutant formation, and management -to plan, manage and report the work. The new programme on flame fluctuations and NO_x formation involves development of a detailed model of NO_x formation. Measurements - to determine the effects of large scale eddies and temperature fluctuations on NO_x formation, and modelling - to incorporate and validate improved models for NO_x formation. The IEACCS programme includes effective and economic industrial solutions to the use of a great variety of fuels and the minimisation of the environmental impact of coal burning. (author).

44458 (VTT-TIED–947) **Experiments on the combustion of small peat particles in an entrained-flow, isothermal furnace.** Saastamoinen, J. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 23p. Order Number DE89787763/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The combustion of pulverized peat has been examined in the drop tube furnace by using air as the atmosphere. There is a great lack in the measurement data for peat and other biomass fuels compared with coal in a prescribed atmosphere. The results can be used to compare the combustion behaviour of peat with that of coal by using the results for coal. This can give information about the suitable particle size of peat in order to obtain a similar combustion behaviour in a furnace, when coal is replaced by peat. The measurement data are also valuable for the modelling work. There is need for experimental data for pulverized biomass fuels in an inert atmosphere. Biomass fuels have a great fraction of volatile matter, and the results are required for the modelling of pyrolysis.

44459 (VTT-TIED–962) **Development of efficiency. Energy mass and mass balance calculation for boilers.** Paakkinen, K.; Heikanen, V.-P.; Vartiala, H. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1989. 73p. (In Finnish). Order Number DE89787764/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

An efficiency and balance calculation method, based on DIN 1942 standard, was developed. The aim of the research was to determination of losses caused by grate slag and fly dust. In methods in general use (based on the DIN 1942 standard) the incomplete combustion of the fuel and its effect on different flows of matter are not well enough considered. Carbon, sulfur and nitrogen balances are used in addition to traditional mass and energy balances. The DIN 1942 standard calculation of enthalpy of flue gas, and power loss of carbon monoxide was adjusted. The two calculation methods were compared using two case examples. The elementary method lowered the efficiency by 0.13%. The difference between results is affected by different ash content. The change from 3.4 mass percents to 6 mass percents lowers the efficiency by approximately 0.25%. In combustion processes the efficiency and mass balance are affected by mass fraction of volatiles of the ashes. In order to detect this effect, a determination of volatile compounds of fuel, grate slag and fly dust was included in the method. In the method based on the standard, a value of brown coal found in the literature

was used as value for domestic fuel. The method developed made the mass balances more accurate and hence also the determination of emissions. In the examples, the mass flows of grate slag were increased by 31.6% and 17.2% in the case where the values of brown coal were used as mass fraction the volatiles of the ashes in the calculations (DIN 1942). The accuracy increase of enthalpy determination of flue gases adjusted the efficiency by approximately 0.06%. The calculation method has been added into the microcomputer based general calculation program of the Domestic Fuel Laboratory, in which it may be used in determination of parameters of flue gas emissions and combustion processes in addition to efficiency and balance calculations.

0150 Marketing and Economics

Refer also to citation(s) 45227

44460 (OY/PSTL-TIED–62) **Peat-Environment-Society; Part 1: Income and employment effects of production and energy use of peat.** Tervo, M. Oulu Univ. (Finland). Research Inst. of Northern Finland. Mar 1989. 38p. (In Finnish). Order Number DE89787760/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The investments required by production and energy use of peat as well as the employment and income effects of them are studied in this research. Oulu/Toppila thermal power plant has been used as an example for peat supply and utilization chain. The employment effects are also estimated on the level of the whole country. The effects of investments of peat fuel supply and utilization and employment are compared with resembling effects of imported fuels. The investments of utilization chain of Oulu/Toppila power plant, counted for the utilization time of 25 yars, are about 770 million FIM (1988 price level). The portion of power plant is 440 million FIM, investments for peat bogs 80 million FIM, peat production equipments 160 million FIM and peat loading and transportation equipments 70 million FIM. The employment effects are totally about 350 working years, 80 years in the power plant, in production and transportation 240 years. The income effects of peat production are about 45 million FIM, about 40% of which remain in the production communes and the rest floats out of these communes. The capital demand of a thermal power plant is high when using coal as fuel, the demand when using peat is about 90%, with oil 70% and with natural gas about 50% of the capital demand of a coal fired power plant.

44461 (PB–89-197800/XAB) **Cost comparison of selected US and Australian coal mines.** International Trade Administration, Washington, DC (USA). Office of Energy. Apr 1989. 144p. Available from NTIS, PC A07/MF A01.

Also available from Supt. of Docs. See also PB–86-184686.

This study is the third of several country reports to fulfill the second part of a two-part congressional directive to analyze the potential for increased imports of steam coal into the United States.

0160 Health and Safety

Refer also to citation(s) 44447

02 PETROLEUM

44462 (CPA–1988) **Canadian Petroleum Association annual report, 1988.** Canadian Petroleum Association, Calgary, AB (Canada). 1988. 52p. (In English and French). (MICROLOG–89-03778). Available from Canadian Petroleum Association, 3800 150 6th. Ave. S.W., Calgary, Alta., CAN T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report describes the year's activities of an association whose active membership comprises companies of all sizes engaged in Canada's oil and natural gas exploration, production and pipelining. They produce about 80% of Canada's oil and 70% of its gas, and account for more than 75% of the upstream sector's spending. Some data on overall performance of the member companies is provided. A Board of Governors directs the affairs of the association and develops its policies. Policies unique to British Columbia, Saskatchewan, the frontiers and pipelines are addressed by specific divisions. Work which is general to the industry is carried on by 50 standing committees, working in such areas as environment and socio-economic development, oil spills, oil policy, industry operations, and public affairs. The association also provides statistical and technical information and addresses requests for information from companies and government agencies. The many committees and task forces provide the necessary information for policy formulation. The resulting policies are communicated to governments, regulators, other associations and the public. The association provides a focal point for member companies to develop consensus and for governments and the public to obtain an industry perspective. 8 figs.

44463 (DOE/FE–0139) **Federal oil research: A strategy for maximizing the producibility of known US oil.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of the Deputy Assistant Secretary for Oil, Gas, Shale and Special Technologies. Aug 1989. 27p. Sponsored by U.S. DOE Fossil Energy. Order Number DE89015643/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The US contains a massive resource of oil that has already been found, but which remains in known reservoirs after conventional production has reached its practical limits. This resource, over 340 billion barrels–2/3 of all oil ever discovered in the US–cannot be economically produced with currently available extraction technology and our current level of understanding of fluid flow in reservoirs. Improvements in both geological understanding and extraction systems will result from focused, interdisciplinary research and development. Although estimates vary widely, successful R and D could make producible as much as 80-100 billion barrels of this known oil–enough to sustain US production at current levels for the next 30–40 years. The realization of this potential has been the Federal oil program goal since its inception. This document, after summarizing the current situation, traces the program evolution and describes its present status. A knowledge of how the program has evolved provides a more informed perspective on the current effort. The document concludes with a brief discussion of the current strategy and its expected benefits. 45 refs.

44464 (INA/NOGAP–8903) **NOGAP bibliography, vol.3.** Department of Indian and Northern Affairs, Yukon, YT (Canada). Northern Oil and Gas Action Program. 1989. 45p. (MICROLOG–89-02697). Available from NOGAP Secretariat, Constitutional Development and Strategic Planning Branch, Indian and Northern Affairs Canada, Les Terrasses de la Chaudiere, Ottawa, ON, CAN K1A 0H4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This bibliography contains references and summaries of published and unpublished reports produced under the NOGAP (Northern Oil and Gas Action Program). It includes all the reports produced with, even partial, help from the NOGAP and and presented to the Secretarial Office of the program between January 31 and July 29, 1988. The majority of these reports have not been published yet. The bibliography is organized according to the names of the participants in the NOGAP and according to the titles and project numbers. 94 refs.

44465 (OPI–1989) **Index to Ontario Petroleum Institue, Inc. Technical vols. 1 to 26.** Ontario Petroleum Inst., Inc., Chatham, ON (Canada). [1989]. 26p. (CE–02681). Available from Ontario Petroleum Institute, Inc., 70 Talbot Road South, Box 340, Lambeth, ON, CAN N0L 1S0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This bibliography presents a list of reports and speeches found in the volumes published by the Ontario Petroleum Institute, arranged by subject and by author. The topics covered include geology, drilling, legislation, financing, taxes, geophysics and geochemistry, refineries, and treatment and testing.

0201 Reserves

Refer also to citation(s) 44424

44466 (CMI-R–30850-2) **Resource situation in a global perspective.** Hefting, T. Christian Michelsens Inst. for Vitenskap og

Aandsfrihet, Bergen (Norway). Jul 1988. 25p. (In Norwegian). Order Number DE89914751/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report gives a short survey of the main characteristics of the global oil resources i.e. production, consumption and sources. It deals briefly with the future oil sources and the global economic picture on the oil sector. 18 figures.

44467 (DOE/FE–0116-1) **Strategic petroleum reserve: Quarterly report.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Office of Petroleum Reserves. 15 May 1989. 8p. Sponsored by U.S. DOE Fossil Energy. Order Number DE89016549/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This May 15, 1989, Strategic Petroleum Reserve Quarterly Report describes activities related to the site development, oil acquisition, budget and cost of the Reserve during the period January 1, 1989 through March 31, 1989.

44468 (SAND–88-3262) **Radar logging of storage cavern walls at the Strategic Petroleum Reserve: A feasibility estimate.** Castle, J.G. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 48p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC04-76DP00789. Order Number DE89016928/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The feasibility of using a radar logging tool to map the salt walls in the caverns storing crude oil at the Strategic Petroleum Reserve (SPR) is examined. The tool design has dimensions small enough to permit entry into every SPR cavern at Big Hill, Bayou Choctaw, West Hackberry, and Bryan Mound, is able to resolve wall features as small as five feet, and can measure the range to the cavern wall with an uncertainty less than one foot. Usable radar echoes are predicted if the walls are very rough in 37 of the 45 storage caverns during operation at 1 GHz. Dependence on frequency and wall roughness is presented. Very strong echoes are to be expected in most caverns at 1 GHz. 11 refs., 5 figs., 5 tabs.

0202 Geology and Exploration

Refer also to citation(s) 44489, 44490, 46169, 46343

44469 (DGMK–361) **Kerogenous and bituminous intercalations within the Hauptdolomit (Upper Triassic, Eastern Alps): Model of a carbonate source rock. Final report.** Koester, J.; Fries, W.; Bechstaedt, T.; Kulke, H. Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Geologie und Palaeontologie; Freiburg Univ. (Germany, F.R.). Geologisches Inst.; Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). Jun 1989. 309p. (In German). Available from Copy held by UB/TIB Hannover.

Within the Upper Triassic carbonate platforms of the Eastern and Southern Alps kerogenous sediments were formed under marine, mesohaline conditions during periods of low sea level stands. These frequently sub-mm laminated marls and carbonates were deposited in small restricted lagoons and tectonically formed special basins. Alginitic and amorphous organic matter with a high bacterial contribution dominates by far. Biomarker data demonstrate a maturity range from immature to overmature (0.4 - > 3% R_0) as well as source differences. Microbial sulfate-reduction was the most important metabolic process within the anoxic-sulfidic environment during early diagenesis. This resulted in the formation of a sulfur-rich kerogen and controlled the dolomitization of the laminites. The concentration of Cu, Zn, Ni, Mo, V, U generally is related to the kerogen, clay mineral, and pyrite content of the HCl-insoluble fraction. (orig.) With 19 tabs., 125 figs.

44470 (GS–89-1H, pp. 53-58) **Sedimentology and implications for hydrocarbon exploration of the "Hippa beds", Queen Charlotte Islands, British Columbia.** Higgs, R. (Cordilleran and Pacific Geoscience Div., Sidney, BC, Canada). Geological Survey of Canada, Ottawa, ON (Canada). 1989. (MICROLOG–89-02837). In *Current research, part H. Frontier geoscience program, Queen Charlotte Islands, British Columbia.* Available from Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The "Hippa beds," known from a single outcrop on Hippa Island, comprise up to 200m of conglomerate, sandstone and mudstone of uncertain age. These deposits lie uncomfortably beneath Tertiary Masset Formation volcanics. The existence of the Hippa beds demonstrates that rocks with petroleum-reservoir potential may occur, at no great depth, beneath the extensive Masset outcrop of adjacent Graham Island. Three facies were recognized. The first consists of mudstone with 10-20 cm thick sandstone interbeds, interpreted as offshore lacustrine deposits. The second and third consist, respectively, of conglomerate with crude horizontal stratification, and trough cross-stratified coarse sandstone; these are interpreted as braided-stream deposits. Paleoflow was toward the southwest. It is suggested that the Hippa beds are Tertiary of Late Cretaceous. The presence of conglomerate implies nearby synsedimentary uplift; this tectonic episode may be the same one responsible for the conglomeratic Honna Formation (Coniacian) of the Queen Charlotte Islands. 10 refs., 4 figs.

44471 (GS–89-1H, pp. 47-52) **The middle Cretaceous Haida Formation. A potential hydrocarbon reservoir in the Queen Charlotte Islands, British Columbia.** Fogarassy, J.A.S. (Cordilleran and Pacific Geoscience Div., Vancouver, BC, Canada); Barnes, W.C. Geological Survey of Canada, Ottawa, ON (Canada). 1989. (MICROLOG–89-02837). In *Current research, part H. Frontier geoscience program, Queen Charlotte Islands, British Columbia.* Available from Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Petrographic examination of newly collected sandstone samples of the Haida Formation indicates hydrocarbon reservoir development. Increasing mineralogical and textural maturity, primarily quartz framework grain content and sorting, may be related to the Rennell Sound fold belt. Regionally, visual porosity increases in a southerly direction, with values exceeding 15% observed at the head of Cumshewa Inlet. Improved reservoir characteristics and the blanket nature of the Haida sandstones combine to create a strong hydrocarbon objective in Hecate Strait. 8 refs., 6 figs.

44472 (IKU-R–22.1864.00/02/88) **Modelling of hydrocarbon generation patterns in the Egersund Sub- basin, North Sea.** Ritter, U. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Apr 1988. 44p. Order Number DE89914732/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Hydrocarbon generation in the Egersund Sub-Basin on the Norwegian continental shelf has been using empirical (Lopatin-type) and kinetic models and two prototypes of source rocks from wells 9/4- 4 and 18/1-1. The amount of oil generated changes with initial heat flow, type of generation model, activation energies and source rock richness but does not follow a straigthforward pattern. For example at lower thermal histories the amount of oil generated up to the present changes exponentially with initial heat flow; variation due to change of activation energy distribution is linear to exponential, depending on heating rate; and variation due to source rock potential is linear. The empirical model for oil generation is less sensitive to temperatu- re and more sensitive to time than the kinetic models and appears to overestimate the amount of oil generated at low heating rates but underestimates it at high heating rates. Hydrocarbon yields predicted by the empirical model are usually 4 to 5 times higher than those predicted by the kinetic models. For the drainage area of well 9/2-1 variation of initial heat flow between 1.15 and 1.25 hfu (heat flow units) results in a variation of output yield by a factor three. If a minimum oil saturation of the pore volume of 10% is required for long-distance migration, the empirical model should have resulted in accumulations or oil shows also in the marginal drainage areas. Although not unambigous, the present hydrocarbon distribution can be explained best by generation from the kinetic model thermal histories represented by initial heat flows between 1.20 and 1.30 hfu. 25 refs., 8 figs., 3 tabs.

44473 (NEI-NO–68) **Practical aspects of modeling in exploration and development.** Norsk Petroleumsforening, Oslo

(Norway). 1986. 300p. (CONF-8603265--: Practical aspects of modeling in exploration and development, 3-5 Mar 1986). Order Number DE89914769/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The conference proceedings contain 24 papers. The topics covered are: What modeling do we need? An interpreter's viewpoint; Optimized acquisition and processing for simplified modeling in interpretation; A review of modeling as a tool in marine seismic survey planning; Inversion of zero-offset seismic data; The realistic simulation of field data in complex areas: a pre-stack, wave equation solution; Velocity field and velocity error modeling - an essential accompaniment to wave-theoretical migration in 2-d and 3-d; Migration and velocity modeling - an interpreter's tool; Applications of asymptotic ray tracing techniques in seismic processing; 3d modeling as an integrated part of a comprehensive exploration system; Combined interpretation of gravity and seismic data. A case history in coastal basins of Marocco; Interactive constrained inversions of gravity and magnetic data in 2.5 d and 3d; Integration of interactive gravity and magnetic modeling into the seismic interpretation process; Removal of the vsp downgoing wave in the presence of very steep dips: A practical solution; Interactive model-based vsp-cdp transform; Applications of 2d and 3d seismic modeling in survey design and interpretation; Applications of non-normal incidence vsp modeling. Case history on data from offshore Norway; Offset dependent amplitude analysis by lithological modeling of data from offshore Norway; Interpretation and modeling of amplitude versus cdp gather offset; Structural and lithologic modeling - two case histories; Modeling of a complex salt diapir in the Tromsoe basin; A software package for kinematic and dynamic ray tracing in 3d; Forward seismic modeling in two and three dimensions using the boundary integral equation approach; Interactive modeling of complex geological structures from 3d seismic interpretations; Modeling and interactive interpretation. No separate abstracts were prepared.

44474 Downhole pulse radar. Chang, H.T. To Dept. of Energy, Washington, DC. USA Patent 4,814,768. 21 Mar 1989. Filed date 28 Sep 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A borehole logging tool generates a fast rise-time, short duration, high peak-power radar pulse having broad energy distribution between 30 MHz and 300 MHz through a directional transmitting and receiving antennas having barium titanate in the electromagnetically active region to reduce the wavelength to within an order of magnitude of the diameter of the antenna. Radar returns from geological discontinuities are samples for transmission uphole.

0203 Drilling and Production

Refer also to citation(s) 44622

44475 (DGMK–202-4/1) **Evaluation of criteria for selection, preparation and performance of field studies on the scope of enhanced oil recovery by technical CO_2. Final report. Pt. 1.** Albertsen, M. Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung; Institut fuer Erdoelforschung, Clausthal-Zellerfeld (Germany, F.R.); Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). May 1989. 43p. (In German). Contract BMFT 03E-6083-B. Available from Copy held by UB/TIB Hannover.

Most of the German oil fields are showing reservoir pressures of such a low range that the suitable miscibility for oil displacement by CO_2 can not be expected. Moreover, pure CO_2 is expensive in production so that a potential for EOR is to expect at soonest in the application of unpure technical gases below miscibility. This type of application is investigated from various viewpoints. The availability of cheap technical CO_2 from different sources is evaluated. By a series of flood experiments the effectiveness of unpure CO_2 to mobilize residual oil below miscibility is investigated. A detailed analysis of pvt behaviour and phase composition is used for the interpretation of results. Finally, the experimental results are used as basical data set to describe the oil displacement process by reservoir simulation programs. (orig.) With 10 tabs., 12 figs.

44476 (DGMK–202-4/2) **Evaluation of criteria for selection, preparation and performance of field studies on the scope of enhanced oil recovery by technical CO_2 - experimental investigations. Final report. Pt. 2.** Hollerbach, A.; Meyn, V.; Pusch, G.; Kayser, C.; Kessel, D.; Meyn, R.; Swaid, I. Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung; Institut fuer Erdoelforschung, Clausthal-Zellerfeld (Germany, F.R.); Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). May 1989. 173p. (In German). Contract BMFT 03E-6083-B. Available from Copy held by UB/TIB Hannover.

In continuation of the previous DGMK-project 202/3 (03E-6083-A) concerning the displacement and extraction behaviour during CO_2-flood processes it was necessary to investigate the effects of impurities as N_2 in a further phase. Characteristic physical and chemical parameters were determined for two oils of different quality and chemical composition by PVT-methods, chemical analysis of equillibrated phases and samples taken from flood experiments. Partition coefficients demonstrate that minor impurities of 15% N_2 raise the minimum miscibility pressure (MMP) and reduce the oil recovery to a great extent in respect to a multiple contact miscibility process. Below the MMP the displacement efficiency of the linear flood processes is correlated to the density of the flood media. This is valid even with density variation due to impurities like N_2. The slug size of 0,4 PV is required to displace the oil effectively as shown by the distribution of residual oil saturations and the composition of the immobile phases. (orig.) With 63 tabs., 82 figs.

44477 (DGMK–202-4/3) **Evaluation of criteria for selection, preparation and performance of field studies on the scope of enhanced oil recovery by technical CO_2. Final report. Pt. 3. Numerical simulation.** Mueller, T.; Pusch, G.; Leitenbauer, J. Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Tiefbohrtechnik, Erdoel- und Erdgasgewinnung; Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). May 1989. 179p. (In German). Contract BMFT 03E-6083-B. Available from Copy held by UB/TIB Hannover.

The planning of partial or completely miscible gas injection projects requires the use of a compositional simulator. In this sutdy the capability of a compositional simulator was investigated to predict the phase and flow behaviour under MCM and partial miscibility conditions for two reservoir oils. In spite of the complicated composition of the two crude oils the phase behaviour and the phase properties could be successfully predicted by adjusting and lumping the medium and heavy components into three pseudocomponents. The prediction of the flow behaviour of the phases dominantly depends on the interfacial tension of the phases. The mathematical descriptions could be improved by the development of a new correlation function. The results of this study have enhanced the knowledge about the applicability of compositional simulators and show the user, which criteria have to be considered for an appropriate data selection and accurate process modelling. (orig.) With 32 tabs., 63 figs.

44478 (DGMK–202-4/4) **Evaluation of criteria for selection, preparation and performance of field studies on the scope of enhanced oil recovery by technical CO_2. Final report. Pt. 4. Procedure of technical CO_2 at substantial lower costs compared to pure CO_2.** Trieloff, H.J. Preussag A.G. Erdoel und Erdgas, Hannover (Germany, F.R.); Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). May 1989. 69p. (In German). Contract BMFT 03E-6083-B. Available from Copy held by UB/TIB Hannover.

High costs for CO_2 resulting from earlier DGMK investigation made it advisable to check proposed processes and calculated costs. Two items were handled under main concern: 1. Reduction of CO_2-purity. 2. New processes for production and upgrading. As a result conventional purification processes dont't provide substantial cost reduction. More recent processes were investigated concerning reduced CO_2-purity simultaneously. Here membran processes show best advantages. However, in USA these processes are in most cases used for CO_2 bulk removal only. Little chances can be seen for cheap CO_2 coming from processes on site (e.g. integrated gas

turbine processes) as several products have to be sold simultaneously based on long-term contracts. In summary prospects for low-price CO_2 are not very promising. On the other hand substantial cost reduction for CO_2 flooding could be expected, if CO_2 has to be removed from stack gases due to environmental duties. (orig.) With 6 tabs., 18 figs.

44479 (DOE/BC/14126–9) **Nucleation and pore geometry effects in capillary desorption processes in porous media: Topical report.** Parlar, M.; Yortsos, Y.C. University of Southern California, Los Angeles, CA (USA). Dept. of Petroleum Engineering. Aug 1989. 43p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87BC14126. Order Number DE89000757/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A percolation model previously developed by the authors for adsorption-desorption phenomena in porous solids (J. Colloid Interface Sci. 124, 162 (1988)), is extended to include nucleation effects during desorption, and to general size distributions of pore bodies and pore throats. Conditions under which nucleation is likely to be important are delineated. For such cases, desorption is treated as a growth problem with continuous generation of source sites. Accessibility functions are derived for Bethe lattice representations of the porous medium. Similar calculations are presented for the case when pore bodies and pore throats take arbitrary size distributions. The latter find also applications to other related processes in porous media. In view of the theory presented, the interpretation of experimental sorption isotherms is further discussed. 38 refs., 11 figs.

44480 (DOE/BC/14126–10) **Capillary effects in steady-state flow in heterogeneous cores.** Yortsos, Yanis C.; Chang, Jincai. USDOE Bartlesville Project Office, OK (USA); University of Southern California, Los Angeles, CA (USA). Dept. of Petroleum Engineering. Aug 1989. 32p. Sponsored by U.S. DOE Fossil Energy. DOE Contract FG22-87BC14126. Order Number DE89000758/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Effects of capillary heterogeneity at the macroscopic scale have previously been analyzed for static conditions or in the context of outflow end-effects. This paper presents a systematic study for the case of one-dimensional, steady-state flow, that complements recent work on transient displacement (Chang and Yortsos, 1989). We consider the saturation response to various forms of heterogeneity. Included are analytical results for certain model cases, some general results, and numerical solutions for variously correlated spatial variations. The sensitivity to process parameters, such as rate and heterogeneity length scale and correlation, is studied. Physical interpretations are offered, and potential applications in the estimation of heterogeneity are discussed. 15 refs., 13 figs.

44481 (DOE/METC–88/0261) **Gas miscible displacement enhanced oil recovery: Technology status report.** Watts, R.J.; Komar, C.A. (eds.). USDOE Morgantown Energy Technology Center, WV (USA). Jan 1989. 61p. Sponsored by U.S. DOE Fossil Energy. Order Number DE88001050/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Research on gas flooding and miscible displacement, with an emphasis on improvement of CO_2 flood performance is described. Low reservoir volumetric sweep efficiency is the major problem associated with gas flooding and all miscible displacements. CO_2 flooding would be considerably more efficient if a larger area of the reservoir could be contacted by the gas. Current research has focused on mobility control, computer simulation, and reservoir heterogeneity studies. Three mobility control methods have been investigated: the use of polymers for direct thickening of high-density carbon dioxide, mobile "foam-like dispersions" of carbon dioxide and aqueous surfactant, and in situ deposition of chemical precipitates. 17 refs., 22 figs., 8 tabs.

44482 (DTH-LET-RE–88-7) **Simulation of miscible gas displacement with a finite element compositional simulator.** Fjellerup, J.S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. Sep 1988. 197p. Order Number DE89914670/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The purpose of the project has been to study miscible gas displacement in oil reservoirs, theoretically and experimentally. In the theoretical part, a one dimensional finite element compositional simulator has been developed for solving miscible two phase flow in porous media. The model is fully implicit and solves the pressure and composition equations in sequence. Dispersion is included in the model, and improvements in the calculation of the Jacobian are outlined. In the experimental part, PVT (near critical) - and slimtube experiments have been performed using reservoir oil and injection gas from the Danish Gorm field. The minimum miscibility pressure (MMP) was determined to be as high as 48-50 MPa. The slimtube experiments have been simulated using parameters matched to the PVT experiments, and the model gave a correct prediction of the MMP. In a convergence test, the model needed 20-40 elements to converge when the displacement front is sharp, and for the range of parameters investigated, the model was more sensitive to the time step size than to the number of elements. The model has been compared with a finite difference (f.d.) model, and the two models converged to the same results, however the f.d. model needed 100-150 blocks to converge. Besides the mentioned experiments, som rich gas displacements (literature) with limited PVT data have been simulated with the finite element model, which gave a 3-5% overprediction of the oil recovery. Apparently, MMP predictions can be improved if the slimtube simulator is tuned to PVT data in the near critical region. (author) 50 refs.

44483 (IKU-R–34.2780.00/01/88) **Miscible displacement yearly report 1988.** Glasoe, Oe. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Dec 1988. 47p. Order Number DE89914750/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The microscopic displacement efficiency of synthetic oil by horizontal nitrogen flooding at different water-saturations in characterized sandstones have been investigated. The characteriza- tion of the cores include determination of average grain size, pore size distribution and longitudinal dispersion coefficients. The interpretation of the results obtained from the displacement tests are based upon both experimental and calculated data. 25 figures, 6 tables.

44484 (IKU-R–34.2785.00/01/88) **Summary of some aspects of WAG and tertiary gas injection.** Holt, T.; Munkerud, P.K. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Dec 1988. 86p. (In Norwegian). Order Number DE89914733/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

This report has been written as a result of a litterary study of water/alternating gas (WAG) and tertiary gas injection after waterflooding. After a general introduction, the problems of gas injection and sweep efficiency are discussed. Then a description of water/gas processes follows, with special emphasis on WAG, and where the significance of various factors are included. Then common problems of the WAG process and tertiary gas injection are discussed. Effects of a possible shielding of oil from gas because of high water saturation, are thoroughly analyzed. Flow of up to three phases in porous media, with special emphasis on the measurement of three phase relative permeabilities, are then treated. Finally, experiences from some field tests with WAG and tertiary gas injection are summarized and discussed. 87 refs., 32 figs., 6 tabs.

44485 (NEI-DK–192) **Presentation of low cost contribution to hydrocarbon projects.** Industri- og Handelsstyrelsen, Copenhagen (Denmark). Formidlingsraadet. Jan 1989. 164p. (CONF-8709461–: Hearing on presentation of low cost contribution to hydrocarbon projects, 22-23 Sep 1987). Order Number DE89914663/JAW. Available from NTIS (US Sales Only), PC A08.

A one and a half day symposium held in September, 1987, in Aalborg, Denmark, where the aim was to present and discuss some research and development projects concerned with the reduction of the cost of hydrocarbon exploitation and production and to promote a dialogue between the project teams and the users of high technological products. The five projects which were presented covered the subjects of enhanced oil recovery, two phase flow, subsea systems and shallow waters, integrated pipeline management systems and marginal fields. (AB).

44486 (NEI-DK–192, pp. 10/5-10/15) **Platform concept for marginal fields.** Olsen, K.B. (Ramboell og Hannemann, Consulting

Engineers and Planners A/S, Virum (DK)). Industri- og Handelsstyrelsen, Copenhagen (Denmark). Formidlingsraadet. Jan 1989. (CONF-8709461--: Hearing on presentation of low cost contribution to hydrocarbon projects, 22-23 Sep 1987). In *Presentation of low cost contribution to hydrocarbon projects.* Order Number DE89914663/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The purpose of the project is to examine the economy in production of hydrocarbons from marginal fields in the North Sea shallow waters. To achieve this, a number og options has been considered resulting in the identification of the concepts of a lightweight jacket and a monotower, remotely controlled from a central production platform. In order to enhance the oil recovery as much as possible, several production features have been considered: 1. Conventional process with oil/gas separation, 2. Hydraulic/electrical downhole pumps, 3. Multiphase pumps. Two of the three features have been studied in connection with the two different support structure options. The multiphase pump has only briefly been considered. A cost estimate has been performed and used in an overall economic evaluation with special emphasis on the Danish taxation model. A number of options for the topside design of marginal platforms has been considered in conjunction with two different support structures, namely the lightweight jacket and the montower. The project was undertaken by Ramboell and Hannemann in cooperation with Aalborg Vaerft Offshore and was funded jointly by the European Economic Community and the Danish Industrial Liaison Council. Britoil Plc, U.K., provided the necessary technical assistance for the topside facilities as an experienced oil operator in the North Sea. (author).

44487 (NEI-DK--192, pp. 6/1-6/42) **Enhanced oil recovery.** Bjerrum, A. (COWIconsult (DK)). Industri- og Handelsstyrelsen, Copenhagen (Denmark). Formidlingsraadet. Jan 1989. (CONF-8709461--: Hearing on presentation of low cost contribution to hydrocarbon projects, 22-23 Sep 1987). In *Presentation of low cost contribution to hydrocarbon projects.* Order Number DE89914663/JAW. Available from NTIS (US Sales Only), PC A08.

The preliminary result of a three year project lead by a Danish consultant firm on enhanced oil recovery financed by the EEC Commission and the Danish Liason Council. The aim was to highlight some critical aspects of gas injection and water flooding. Aspects examined were the determination of the reservoir pressure required to obtain miscibility between the reservoir fluid and the injected gas (slim tube), determination of chalk wettability properties and determination of oil displacement at reservoir pressure for three recovery methods (HC gas injection, nitrogen injection and water flooding). (AB).

44488 (NEI-DK--192, pp. 8/1-8/9) **Subsea system for shallow waters.** Ottesen Hansen, N.-E. (LICengineering A/S (DK)); Olsen, K.B. Industri- og Handelsstyrelsen, Copenhagen (Denmark). Formidlingsraadet. Jan 1989. (CONF-8709461--: Hearing on presentation of low cost contribution to hydrocarbon projects, 22-23 Sep 1987). In *Presentation of low cost contribution to hydrocarbon projects.* Order Number DE89914663/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

In several areas marginal fields are located in rather shallow seas (up to 90 m water depth) with strong environmental forces due to waves, to currents and to ice or in areas with dense shipping traffic. For the deeper part of these areas subsea systems can be economically attractive alternatives compared with light weight platforms or with cenventional jacket platforms. Such a subsea system has been developed. It consists of 4 oil wells in series on a flowline and a testline with a distance of 30 km from the process facility. It can be developed in stages. The initial production with all wells completed is 8000 BBL/D dropping off to 3000 BBL/D over a period of 10 years. The christmas trees selected are diver installed converted topside trees which fit mudline suspension systems. The control system developed is of the multiplexed electrohydraulic type consisting of standard components. A propotype of the system was build and tested and showed good reliability. Further valve spools and control modules are developed to be easily installed and retracted by light diving support vessels. Finally a low cost protection frame against interference from fishing gears and underscour is developed. (author).

44489 (NEI-NO--66) **Second northern European drilling conference.** Norsk Petroleumsforening, Oslo (Norway). 1985. 256p. (CONF-8510513--: 2. northern European drilling conference, 21-23 Oct 1985). Order Number DE89914739/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

The conference proceedings contain 15 papers. The topics covered are: Petroleum Research Center: What can it offer to the industry; Subsea production wells in the Gullfaks field; Shallow gas: coping with its hazards offshore; New kill and choke-line concept; Downhole blowout preventer; New concepts on return flow measurements; Shallow gas - its impact on exploration and development drilling; Odin tender support vessel; Experience wish and new development in drilling in cold environment. Problems related to cold harsh environment views and solutions; New concept within drilling and pipehandling; Experience with top- drivers; Developments in cuttings cleaning; Central hydraulic systems. No separate abstracts were prepared.

44490 (NEI-NO--67) **Experiences and new developments in well completion.** Norsk Petroleumsforening, Oslo (Norway). 1986. 339p. (CONF-8603264--: Experiences and new developments in well completion, 17-19 Mar 1986). Order Number DE89914768/JAW. Available from NTIS (US Sales Only), PC A15/MF A01.

The conference proceedings contain 14 papers. The topics covered are: Field experiences - The Frigg field; Field experiences - The Statfjord field; An alternative gravel packing fluid for deviated wellbores; Exploration - Production wells conversion; the protection of downhole instruments from shocks of tubing conveyed perforating; Premium connection - Hydril/Vam AG; Elastomers - an overview of downhole seals; Fire resistant X-mas trees/wellheads; Reliability of surface controlled subsurface safety valves - phase II; Subsurface safety valves - past, present, future; SCSSV testing; TFL equipment and experiences; TFL test loop; Support vessels for servicing of subsea wells. No separate abstracts were prepared.

44491 (NEI-NO--70) **Reservoir management in field development and production.** Norsk Petroleumsforening, Oslo (Norway). 1987. 417p. (CONF-8703324--: Reservoir management in field development and production, 30-31 Mar 1987). Order Number DE89914770/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

The conference proceedings contains 11 papers. The topics covered are: Reservoir management philosophy in the production of hydrocarbon resources; Reservoir management philosophy in the production phase, challenges to increased recovery; Production geology philosophy; The Gullfaks field - Development strategy; Improved oil recovery, the importance of new research; The role of reservoir simulation in optimal reservoir simulation in optimal reservoir management; The Statfjord field; The Forties field - Development/production strategy; The Piper field; Summary of conference; Separate abstracts were prepared for three of the papers of the proceedings.

44492 (NEI-NO--70, pp. 40) **Reservoir management in field development and production.** Van Golf-Racht, T.D. (Norsk Hydro A.S., Oslo); De Boer, E.T. Norsk Petroleumsforening, Oslo (Norway). 1987. (CONF-8703324--: Reservoir management in field development and production, 30-31 Mar 1987). In *Reservoir management in field development and production.* Order Number DE89914770/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

Reservoir management represents a multi-disciplinary mode of operation which involves fundamental and applied sciences working in an integrated fashion with a common objective, The concepts involved apply to both the development and the production phases of hydrocarbon exploitation. Recently, the phases have started to overlap, as often is the case in onshore fields, in an effort to develop smaller sized fields and to reduce risks associated with oil price volatility. Furthermore, facilities engineers are often included as members of the reservoir management team. The objective of the reservoir management is to optimize the economic reserves and to prevent non-economic decisions. Inherent uncertainty about the resources is reduced, often in a stepwise approach, control is exercised, and the effectiveness of control measures is monitored. Reservoir management is not a specific functional discipline which involves limited staff resources. Rather it incorporates a philosophy

which affects all levels of staff including higher management. It creates the right atmosphere and mode of operation required to tackle the difficult task of developing and producing hydrocarbon reservoirs efficiently. 13 figs.

44493 (NEI-NO–70, pp. 11) **Role of reservoir simulation in optimal reservoir management.** Thomas, G.W. (Scientific Software-Intercomp. Ltd (UK)). Norsk Petroleumsforening, Oslo (Norway). 1987. (CONF-8703324–: Reservoir management in field development and production, 30-31 Mar 1987). In *Reservoir management in field development and production.* Order Number DE89914770/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

This paper discusses the role reservoir simulators play formulating initial development plans, history matching and optimizing future production and in planning and designing enhanced oil recovery projects. The Hibernia Field in Canada and the Hassi R'Mel in Algeria illustrate how simulation can be used to assist in initial reservoir development. The Lookout Butte Rundle (Alberta) and others are cited to exemplify optimisation of future production plans with the aid of simulation. Finally, applications to several reported Enhanced Oil Recovery (EOR) projects are briefly discussed with major emphasis concentrating on the Bati Raman Field in Turkey. 30 refs.

44494 (NEI-NO–70, pp. 50) **Statfjord field.** Roberts, J.D. (Mobil Exploration Norway Inc.); Mathieson, A.S.; Hampson, J.M. Norsk Petroleumsforening, Oslo (Norway). 1987. (CONF-8703324–: Reservoir management in field development and production, 30-31 Mar 1987). In *Reservoir management in field development and production.* Order Number DE89914770/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

The Statfjord Field, the single largest oilfield in the North Sea, is located on the Norwegian/British boundary between 61 degree 10' and 61 degree 23 ' north. As in many of the fields within the East Shetland Basin, the trap comprises a tilted fault block of Jurassic and Cretaceous shales. The major hydrocarbon reserves are contained in two separate sandstone reservoirs; the deltaic Middle Jurrassic Brent Group and the fluviatile Upper Triassic/Lower Jurassic Statfjord Formation. Both Brent and Statfjord reservoirs exhibit excellent reservoir properties with porosities ranging from 20 to 35 percent and permeabilities ranging up to several darcies. The two reservoirs are not in communication and are being developed separately. A secondary hydrocarbon accumulation is found within the Lower Jurassic marine shelf sandstones of the Dunlin Group Cook Formation. Recoverable reserves for Statfjord Field are currently estimated at 482 million Sm^3 of oil and 88000 million Sm^3 of gas. The oil is undersaturated and no natural gas cap is present. Production from the Fiel commenced in 1979 and to date (1 July 1986) 79 of the planned 97 development wells have been drilled. 8 refs. 4 tabs., 16 figs.

44495 (NEI-NO–90, pp. 10) **Barents Sea program of IKU (Institutt for Kontinentalsokkelundersoekelser).** Bugge, T. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Oseanografisk Senter. 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with the Norwegian exploration program in the Barents Sea comprising the various methods for the collection of data from seismic surveying, shallow sampling, and drilling. 5 figures.

44496 (SRC/PD–P-110-82-E-88) **Separation and characterization of surfactants present in emulsions produced in enhanced oil recovery processed. Final report.** Mourits, F.M.; Shook, C.A. Saskatchewan Research Council, Saskatoon, SK (Canada). Petroleum Div. 1988. 235p. (MICROLOG–89-03120). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This study has been undertaken to characterize the surfactants that stabilize emulsions occurring in enhanced recovery operations of bitumen/heavy oil in Saskatchewan and Alberta. Ultrafiltration using membrane permeation of the produced (free) water phases was the technique applied to separate the surfactants. The best permeation performance was achieved using Nylon-66 0.2 μm membranes, produced water feedstock with all free oil removed, and a permeation cell with the sintered membrane support plate cleaned before each run. Following chemical analysis of the raw permeates, three methods were used to isolate and/or concentrate the dissolved organic matter from the water phases: water removal extraction of the acidified permeates with ethyl acetate, followed by removal of the solvent; and separation by column chromatography into acidic, neutral and basic fractions. The solid products from the first two methods were characterized by elemental analysis and infrared spectroscopy. The ethyl acetate extracts from the second method, the primary products isolated in this study, were further characterized by method including nuclear magnetic resonance (NMR) and gas chromatography/mass spectrometry (GC/MS). Clear trends emerged with respect to the characteristics of the isolated materials. The major constituents were aliphatic carboxylic acids, benzoic acid and derivatives, and phenol and derivatives. Differences were observed in the relative proportions of these constituents, which could be related to the origin of the material. Relative to steamflood materials fireflood materials tended to be more aromatic, have a higher benzoic acids content, an average to low aliphatic carboxylic acids content, and contain only small amounts of phenols. 114 refs., 50 figs., 28 tabs.

44497 (STF–75A88022) **Overview of alarm and shutdown frequencies in offshore production.** Bodsberg, L.; Hokstad, P. SINTEF, Trondheim (Norway). Oct 1988. 10p. Order Number DE89914735/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

The paper provides an overview of alarm and shutdown frequencies in offshore production. The foundation for Scientific and Industrial Research at the Norwegian Institute of Technology (SINTEF) has reviewed nearly 1300 daily activity reports submitted by oil companies to the Norwegian Petroleum Directorate. Estimated frequencies of hazardous situations and spurious activations of safety components are presented. This includes estimates of the alarm rate from process sensors and fire and gas detectors. Furthermore, the main types of hazardous situations and safety component failures are presented. A classification scheme suitable for analysis of dependent failures is given based on the offshore field data. The classification scheme considers all types of failures occuring field operations, such as failures due to natural aging of components (random failures), excessive environmental stresses and human-made mistakes during engineering and operation. The results may be used to identify actions which improve both the safety of an installation and the production regularity. Thus, the results are both from safety as well as from an economic point of view. The results may also be used to identify realistic scenarios for training of personnel in crisis intervention and to improve the reporting frequency of safety alarms and shutdowns. 3 refs., 8 figs.

44498 **Ultrasonic drilling apparatus.** Duran, E.L.; Lundin, R.L. To Dept. of Energy, Washington, DC. USA Patent 4,828,052. 9 May 1989. Filed date 20 Jun 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

Apparatus attachable to an ultrasonic drilling machine for drilling deep holes in very hard materials, such as boron carbide, is provided. The apparatus utilizes a hollow spindle attached to the output horn of the ultrasonic drilling machine. The spindle has a hollow drill bit attached at the opposite end. A housing surrounds the spindle, forming a cavity for holding slurry. In operation, slurry is provided into the housing, and into the spindle through inlets while the spindle is rotating and ultrasonically reciprocating. Slurry flows through the spindle and through the hollow drill bit to cleanse the cutting edge of the bit during a drilling operation.

44499 **Enhanced oil recovery system.** Goldsberry, F.L. To Dept. of Energy, Washington, DC. USA Patent 4,824,447. 25 Apr 1989. Filed date 30 Dec 1986. 8p. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

All energy resources available from a geopressured geothermal reservoir are used for the production of pipeline quality gas using a high pressure separator/heat exchanger and a membrane separator, and recovering waste gas from both the membrane separator and a low pressure separator in tandem with the high pressure separator for use in enhanced oil recovery, or in powering a gas engine and turbine set. Liquid hydrocarbons are skimmed off the top of geothermal brine in the low pressure separator. High pressure brine from the geothermal well is used to drive a turbine/generator set before recovering waste gas in the first separator. Another turbine/generator set is provided in a supercritical binary power plant that uses propane as a working fluid in a closed cycle, and uses exhaust heat from the combustion engine and geothermal energy of the brine in the separator/heat exchanger to heat the propane.

0204 Processing

Refer also to citation(s) 44430

44500 (PB–89-205470/XAB) **Advanced refinery process heater. Final report, (October 1983-September 1988).** Minden, A.C.; Buckley, G.G. Alzeta Corp., Santa Clara, CA (USA). Apr 1989. 93p. (ALZETA–88-711-147). Available from NTIS, PC A05/MF A01.

See also PB–86-203179. Color illustrations reproduced in black and white.

A prototype refinery process heater was designed, built and successfully tested, demonstrating the improvements available to heater design through the use of Zone-Controlled Pyrocore radiant gas burners. The 10 MMBtu/hr rated heater released 17 ppm NOx (corrected to 3% oxygen) under full load operation, the lowest NOx emissions technically and commercially achieved in this type of equipment without the use of post-combustion flue-gas processing. Operating with 400F combustion air preheat and a 500F process fluid outlet temperature, the heater achieved overall thermal efficiencies of 92.8% on a LHV basis due in part to the significantly improved performance of the radiant heat exchange section. The radiant burners used in the heater have been proven in performance and reliability, and have also been shown to be applicable to both new heater designs and retrofits into existing heaters. The improved radiant performance of the heater and the use of 'flameless' radiant burners eliminates tube burn-out failures in both the radiant and convective tube coils, further improving the reliability of equipment based on this design. Three separate U.S. Patents have been issued covering the heater design and the use of Zone-Controlled Pyrocore burners in this application.

0205 Products and By-products

Refer also to citation(s) 45226

44501 (AD-A–207721/2/XAB) **Survey of JP-8 and JP-5 properties. Interim report, October 1987-September 1988.** Bowden, J.N.; Westbrook, S.R.; LePera, M.E. Southwest Research Inst., San Antonio, TX (USA). Belvoir Fuels and Lubricants Research Facility. Sep 1988. 111p. (BFLRF–253). Available from NTIS, PC A06/MF A01.

With the help of the Defense Fuel Supply Center, JP-8, Jet A-1, and JP-5 samples from worldwide sources, representing tenders of products destined for Department of Defense bases, have been received at Belvoir Fuels and Lubricants Research Facility at Southwest Research Institute for evaluation. Inspection data for each sample on DD Form 250 or other data reporting form were also received and entered into a data base. The evaluation of these samples consisted of a few inspection tests for comparison with the data provided by the supplier, and tests related to the use of these fuels in diesel engines, which were measured cetane number, calculated cetane indices by two methods, net heat of combustion, and kinematic viscosity measurements at 40 and 70 C.

44502 (NEI-NO–89, pp. 11) **Diffuse discharges of hydrocarbons from the Statoil Bamble petrochemical plant. Measuring method-measures-effects.** Johannessen, T. Norske Sivilingenioerers Forening, Oslo (Norway). 1987. (In Norwegian). (CONF-8705381–: Clean air conference '87, 4-6 May 1987). In *Clean air conference 1987.* Order Number DE89902378/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - Norske Sivilingenioerers Forening, Pb 2312 Solli, 0201 OSLO 2.

The paper deals with the diffuse discharges of hydrocarbons from a petrochemical plant in Norway. The various measures to decrease the discharges in the period from 1980 to 1986 are quantified by means of tracer telhniques. 7 figures, 1 table.

0206 Health and Safety

Refer also to citation(s) 45888

44503 (NEI-NO–90, pp. 39) **Measurement of the sea-bed settling over the oil and gas deposits in the North Sea by means of the GPS (Global Positioning System).** Grovan, G.; Sannes, T. Norske Sivilingenioerers Forening, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with a project on the use of the positioning and navigation systems of GPS (Global Positioning System) for the measurement and evaluation of the sea-bed settling above the oil and gas deposits on the Norwegian continental shelf. The Macrometer system designed for the measurement is a further development of the VLPJ (very Long Baseline Interferometry) system. The computer program LSQT and four utility programs and techniques are used for the evaluation. The GPS interferometric phase algorithms are added. 9 figures, 8 references.

44504 (VTT-TUTK–593) **Extinguishment of liquid fires with sprinklers and water sprays. Description of the tests.** Kokkala, M.; Andsten, T.; Bjoerkman, J. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1989. 183p. Order Number DE89787766/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

An experimental study of extinguishment of liquid pool fires with plain water has been carried out. The number of extinguishment tests was 109, and some additional tests were made to study the free burn characteristics of the pool fires. The extinguishing system consisted of four open sprinklers or nozzles located symmetrically above a pool lying on a weighing platform. The whole test system was set up inside an 18 m high, 14 m wide, and 27 m long tests hall. Tests were made on ten different liquids with a flash point in the range of -6 deg C to 234 deg C using seven different sprinklers or nozzles. The nozzle height was varied from 3 m to 8 m above the fuel surface. The pool size was varied from 0.4 m^2 to 12 m^2. Most of the tests were made using a 1.6 m^2 circular pool. Temperatures were measured at more than twenty locations both in the plume and in the fuel. Other measurements comprised pressure and flow rate for each nozzle, heat flux to the surroundings, and the weight of the pool. Recordings from each sensor were taken once or twice per second. This report describes the technical details of the experimental arrangement, the direct observations made during the tests, and some direct results of measurements. A more thorough data analysis will be published later.

0207 Marketing and Economics

Refer also to citation(s) 45226, 45230, 45236, 45310, 45399

44505 (CMI-R–30152-2) **Generating oil price processes from economic arguments.** Stensland, G. Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway). Dec 1988. 21p. Order Number DE89914738/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Several ways to generate both continous and discrete processes for the oil price are examined. Each model is based on simple economic arguments. The results are useful whenever an uncertain price enters sequential decision problems. 19 refs.

44506 (DOE/EIA–0380(88/05)) **Petroleum marketing monthly, May 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 29 Jul 1988. 173p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE89015568/JAW. Available from NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.

The Petroleum Marketing Monthly (PMM) is designed to give information and statistical data about a variety of crude oils and refined petroleum products. The publication provides statistics on crude oil costs and refined petroleum products sales for use by industry, government, private sector analysts, educational institutions, and consumers. Data on crude oil include the domestic first purchase price, the fob and landed cost of imported crude oil, and the refiners' acquisition cost of crude oil. Sales data for motor gasoline, distillates, residuals, aviation fuels, kerosene, and propane are presented.

0208 Waste Management

Refer also to citation(s) 45720

44507 (DGMK–388) **Macrophyte-based biological treatment of effluent from a petroleum tank farm. Final report.** Altmann, B.R.; Lilie, R.H.; Nowak, K.E.; Schulz-Berendt, V. Mobil Oil A.G., Hamburg (Germany, F.R.); Industrie Abwasser Technik (IAT), Ganderkesee (Germany, F.R.); Limnologisches Inst. Dr. K.E. Nowak, Ottersberg (Germany, F.R.); Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). May 1989. 140p. (In German). Contract BMFT 02WA8524/1. Available from Copy held by UB/TIB Hannover.

In petroleum tank farms, oily effluent is obtained from tank drainage and drainage of surface water from open areas (such as pumping units). As an ecological and economic alternative to other effluent treatment methods, a macrophyte-based biological treatment plant was operated under practical conditions over a period of three years. The macrophyte-based biological treatment plant, using a combination of reed mace and rushes, is in principle a suitable means of treating such effluent, if corresponding pretreatment stages are installed. During the three-year operating period, a total of 3,700 cubic meters of oily effluent was treated in the macrophyte-based biological treatment plant. The reduction rates for COD, BOD_5, hydrocarbons and other parameters were in the range of 98% and above. (orig.) With 50 figs., 12 tabs., 26 refs.

44508 (MEM–GP83-1) **Subsurface disposal of wastes in Manitoba. Part 1: Current status and potential of subsurface disposal of fluid industrial wastes in Manitoba.** Simpson, F.; McCabe, H.R.; Barchyn, D. Manitoba Dept. of Energy and Mines, Winnipeg, MB (Canada). 1987. 53p. (MICROLOG–87-05971). Available from Manitoba Dept. of Energy and Mines, Legislative Bldg., Room 301, Winnipeg, MB, CAN R3C 0V8; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Subsurface strata with adequate porosity and permeability, and potential for receiving fluid industrial wastes, occupy two main areas in Manitoba: the Hudson Bay region in the northeast, and the Williston Basin region in the southwest. Five main types of waste have been disposed of, stored, or treated in the subsurface of southwestern Manitoba: brines from oil production; spent caustic refinery waste; spent cooling water; sewage; and low salinity brines from Manitoba Hydro's water softening system. Emplacement of wastes underground in Manitoba has been carried out in areas of relatively good well control. Consequently, many of the uncertainties inherent in underground waste management have been minimized, in particular those relating to reservoir geometry of the disposal formation. A regional review of the hydrogeology of southwestern Manitoba and Hudson Bay lowland indicates that a number of hydrogeologic regions and zones can be defined, each with a distinctly different potential for subsurface disposal. Paleozoic strata of the Manitoba lowland region and the Hudson Bay lowland, in general, are not suitable for subsurface disposal other than for natural or non-toxic wastes. The zones most suitable for subsurface disposal are limited to Paleozoic strata of the southwestern upland. The upper zone of the Paleozoic sequence seems to offer the best disposal potential. However, local structural and stratigraphic anomalies occur even within the favorable areas. These features can seriously downgrade the potential of strata for subsurface disposal locally, so detailed evaluation and testing of all proposed disposal sites is essential. 85 refs., 18 figs., 5 tabs.

44509 (NEI-NO–89, pp. 4) **SO_2-removal in oil refineries. Mongstad development project.** Steen-Larsen, J. Norske Sivilingenioerers Forening, Oslo (Norway). 1987. (In Norwegian). (CONF-8705381–: Clean air conference '87, 4-6 May 1987). In *Clean air conference 1987.* Order Number DE89902378/JAW. Available from NTIS (US Sales Only), PC A12/MF A01 - Norske Sivilingenioerers Forening, Pb 2312 Solli, 0201 OSLO 2.

The paper concerns the field of SO_2-removal in oil refineries, and presents the equipment designed for this purpose. The equipment described consists of an electrostatic precipitator and a SO_2 Seawater scrubber. The flue gas is normally conducted into the precipitator where the bulk of spent catalyst particulates is removed. The scrubber removes more than 90% of SO_X by absorption in naturally alkaline sea water. The main control system for the flue gas scrubber is decentralized microprocessor based and is an integrated part of the digital plant control system. 2 figures.

0209 Environmental Aspects

Refer also to citation(s) 46154, 46162

44510 (AD-A–208243/6/XAB) **Toxicity of Jet A (aviation fuel) selected aquatic organisms. Technical report, August 1987-February 1988.** Haley, M.V.; Landis, W.G. Chemical Research, Development and Engineering Center, Aberdeen Proving Ground, MD (USA). Mar 1989. 14p. (CRDEC-TR–047). Available from NTIS, PC A03/MF A01.

JP8 (jet propulsion) is an aviation fuel being considered for replacement of diesel fuel used in the generation of smoke on the battlefield. JP8 is projected to be more economical and also be used as a fuel for the ground machinery used in the transport and dissemination of JP8. Also, fog oil has naphthene constituents above the Occupational Safety and Health Administration (OSHA) standards. JP8 trailing and testing could lead to contaminating surrounding aquatic ecosystems through runoff or wind transport. Therefore, the toxicity of JP8 to aquatic organisms must be known. Jet A (aviation fuel) was substituted for JP8 due to availability and similar distillation procedure. The aquatic toxicity of the soluble fraction of Jet A (aviation fuel) was examined. Acute 48-hr bioassays were performed using the water flea, Daphnia magna, and 96-hr growth inhibition bioassays were performed using a green unicellular alga, Selenastrum capricornutum. All tests were conducted according to guidelines set by the U.S. Environmental Protection Agency (EPA) and the American Society for Testing and Materials (ASTM). The 48-hr EC50 for D. magna was 3.1 mg/L. The 96-hr IC50 for S. capricornutum was 4.2 mg/L.

44511 (CPS–EE-113) **Laser ignition of oil spills. Telescope assembly and testing.** Frish, M; Gauthier, V.; Frank, J.; Nebolsine, P. Environment Canada, Ottawa, ON (Canada). Conservation and Protection. 1989. 27p. (MICROLOG–89-03655). Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A technique for using two coupled lasers to heat and ignite oil spills is described. Outdoor demonstrations have proven the ability to ignite cold crude oil in a simulated Arctic environment, and an engineering design has shown the viability of mounting the needed equipment in a helicopter. The telescope required to focus the pulsed igniter laser from a helicopter hovering at an altitude of 20m has now been assembled. Ignition has been demonstrated at slant ranges between 20 and 30m, with the lasers directed outward from the platform at angles between 0 and 49 degrees from the vertical. In addition, two techniques for automatically focusing the telescope were studied. A passive focusing algorithm was automated by storing an intensity gradient function in computer memory and programming the computer to drive the telescope mirror to the position of maximum intensity gradient. However, the computation time, and hence the focusing time, is too long and computational improvements to this technique may be expensive. In contrast, the semi-passive technique known as point triangulation appears to offer the potential for high speed focusing at low cost. The utility of this technique may be compromised by signal-to-noise limitations, in

which case it would be necessary to resort to a system using a laser rangefinder to measure the distance to the oil pool and instruct a controller to position a focusing mirror based on precalibrated data. 6 refs., 11 figs., 1 tab.

44512 (ER/C–098) **Simple remote sensing for the detection of oil on water, no. 98.** Goodman, R.H. Esso Resources Canada Ltd., Calgary, AB (Canada). Research Dept. 1988. 40p. (MICROLOG–89-02439). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A review is presented of various remote sensing systems that may be applicable to development of a system for the aerial detection of oil spills on water. The advantages and disadvantages of active radar, passive microwave, thermal infrared, near infrared, visible light, and ultraviolet systems are discussed. A system was selected based on the criteria of small size, portability, lack of a requirement for external mounting on an aircraft, ability to operate on its own power or on a standard 28 volt aircraft system, a mission life compatible with air fuel limitations, and real time output capability. The selected system uses three television cameras, one for detecting ultraviolet radiation, one for infrared, and one to record information from navigational and flight instruments. A computer based integration system was designed to obtain a synchronized composite image from those three sensors. A number of tests using this remote sensing system are described. It has been found that the system works well and is reliable, although there are some difficulties in interpreting the infrared data, and information is not provided on oil slick thickness. 53 refs., 15 figs., 1 tab.

44513 (FTC–EE-112) **Tests to evaluate the effect of a waterjet barrier on the burning efficiency of a floating oil slick.** Comfort, G. Fleet Technology Ltd., Kanata, ON (Canada). 1989. 44p. (MICROLOG–89-03657). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A test program, using an outdoor test tank, was conducted to investigate the effect of waterjet oil spill containment barriers on the oil burn efficiency, and to evaluate the effect of the waterjet barrier on the opacity of the smoke plume produced during the burn. It was found that operation of the barrier significantly increased the weight and volume of the burn residue, compared to tests without the barrier. Operation of the barrier was found to produce turbulence on the water surface and to cause the formation of emulsions, which is felt to be the main reason for the observed reduction in burn efficiency. Efforts were made during the tests to minimize emulsion formation; since the tests were done on a relatively small scale (the simulated spill was 5 m in diameter) and for a large burn in the field, emulsion formation is expected to be localized at the barrier perimeter, with the result that higher burn efficiencies would be achieved. The burn efficiency was found to increase significantly with slick thickness. The weight and volume of the burn residue was increased when the waterjet barrier was deployed in a circle for the contained spill tests, as contrasted to the uncontained tests in which the barrier was deployed in a V configuration. The operation of the barrier was found to reduce the opacity of the smoke. 6 refs., 12 figs., 9 tabs.

44514 (NEI-NO–91) **Conference on oil pollution control towards the year 2000.** Norske Sivilingenioerers Forening, Oslo (Norway). 1987. 263p. (CONF-8709435–: Conference on oil production control towards the year 2000, 23-25 Sep 1987). Order Number DE89914775/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

The conference proceedings contain 14 papers. The topics covered are: Oil pollution control in the years 1967-2000; Review of the state of the art in practical oil pollution combat in Norway; Current policy on oil pollution control in Holland; A vision of tracking on oil pollution via satellite; Forecasting oil spill drift and fate; The threat to seabirds; Oil: the threat to fish and fisheries; Arctic oil spill countermeasures technology: related Canadian experience; Oil spill combat in the Arctic - an alternative approach; Problems related to the beach cleaning; Treatment of oil and oily wastes; Why didn't science succeed? Viewpoints on research and development; A review of international cooperation and governmental agreements in connection with oil spill combat - worldwide; The oil spill service centre - Southampton. Separate abstracts were prepared for three papers of the proceedings.

44515 (NEI-NO–91, pp. 30) **Oil pollution control in the years 1987-2000.** Westergaard, R.H. Norske Sivilingenioerers Forening, Oslo (Norway). 1987. (CONF-8709435–: Conference on oil production control towards the year 2000, 23-25 Sep 1987). In *Conference on oil pollution control towards the year 2000.* Order Number DE89914775/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

Changes to be expected in oil pollution control are: Preparedness based on booms and skimmers will be given up for use on the open ocean. It will still be used in coastal waters but to a lesser extent. Dispersion from boats will be more used in smaller spills. Underwater oil blowouts will be dispersed by injecting dispersants into the well. Dispersion of oil on the sea far from land using airplanes, will be given up. Emphasis will skift from corrective to preventive measures. In connection with petroleum drilling it is expected that the responsible authorities will define three danger classes, based on the probability of blowout and the oil spill damage potential. The required preparedness and the restrictions posed will, more than today, be tailored to meet the actual risk. Risk analysis and computer aided risk management will gradually be introduced to the offshore industry in order to be able to manage the continuously changing risk level. The "freedom" to pollute the waters, enjoyed by commercial ships, will be drastically reduced. 13 refs.

44516 (NEI-NO–91, pp. 9) **Vision of tracking on oil pollution via satellite.** Dahlin, H. (Swedish Meteorological and Hydrological Institute). Norske Sivilingenioerers Forening, Oslo (Norway). 1987. (CONF-8709435–: Conference on oil production control towards the year 2000, 23-25 Sep 1987). In *Conference on oil pollution control towards the year 2000.* Order Number DE89914775/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

The last 15 years we have seen many visions and promising ideas about future use of satellites. Fancy pictures, showing different features on land and sea, have been produced from information collected by satelliteborne sensors. We usually get excited of this new view of the earth. But what is operational today, or just experimental, and what will be operational in the future? The vision is that in the year 2000 oil pollution is monitored by a system of satellites - polar platforms - equipped with microwave sensors (Synthetic Aperture Radar, SAR) covering the whole ocean with a repetition period of 3 days. Coastal and other sensitive areas are also covered by airborne surveillance. To follow a discovered oil slick between the satellite passages and before the combatting of the oil, numerical models are used with a much higher accuracy than today. 4 figs.

44517 (NEI-NO–91, pp. 17) **Forecasting oil spill drift and fate.** Johansen, Oe. (SINTEF, Trondheim (Norway)). Norske Sivilingenioerers Forening, Oslo (Norway). 1987. (CONF-8709435–: Conference on oil production control towards the year 2000, 23-25 Sep 1987). In *Conference on oil pollution control towards the year 2000.* Order Number DE89914775/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

This paper includes a discussion of the future of oil spill models in oil pollution control. The main questions discussed are related to the potential user's requirements - the required input data and the concepts and utilities which are available now - and in the near future for designing an efficient system for oil spill forecasting. The shortcomings of former model concepts are examined - and the potentials of more advanced approaches are discussed. The paper concludes that the an efficient forecasting system should be mobile, require only a minimum of computer experience, produce a realistic picture of the oil spill - and be able to provide forecasts on the outcome of alternative combat operations. An efficient system should also include real time access to local environmental observations, as well as regional weather forecasts. Permanent data bases should also be established - related to regional data on crude oils, ocean currents and digital maps. 6 refs.

44518 (PB–89-191381/XAB) **Sea otter oil spill avoidance study.** Davis, R.W.; Williams, T.M.; Awbrey, F. Hubbs Marine Research Inst., San Diego, CA (USA). Apr 1988. 79p. Available from NTIS, PC A05/MF A01.

See also PB–89-158851.

To determine whether acoustic, visual, or olfactory stimuli could be used to move sea otters out of an area in the event of an oil spill, the authors recorded the responses of sea otters to a variety of stimuli during captive studies in Alaska. These findings are similar to those of previous attempts to control the movements of sea otters and other marine mammals and birds. An alternative to herding is to capture otters in the vicinity of the spill and temporarily hold them in captivity. This approach is only practical if the number of otters in jeopardy is small (less than 60) and there is enough time to capture them. Based on the results of the study and previous attempts by the California Department of Fish and Game to herd sea otters, the authors do not think acoustic, visual, and olfactory stimuli are effective deterrents. In the absence of effective methods to keep sea otters out of an oil spill, the emphasis must remain on spill prevention, containment, and cleanup.

44519 (PB–89-194286/XAB) **Oil-field emissions of volatile organic compounds. Final report, April 1988-March 1989.** Viswanath, R.S.; Van Sandt, J.H. Tulsa Dept. of City Development, OK (USA). Apr 1989. 74p. Available from NTIS, PC A04/MF A01.

This report presents data that determine the composition of volatile organic compound emissions from oil production fields in Tulsa County, Oklahoma. Five points in the crude-oil production process were samples: well heads, gathering tasks, oilfield pipeline tanks, pipeline terminal tanks, and refinery crude-oil storage tanks. The samples were collected in Summa polished stainless steel canisters and analyzed by a gas chromatograph with dual flame ionization detectors. The analytical technique looked for ninety specific compounds; thirty were detected and are reported. In general the compounds in greatest abundance were ethane, propane, n-butane, 2-methyl butane, and n-pentane. The data developed are for the composition of the volatile organic compounds; volatile organic-compound emission rates were not determined.

44520 (PB–89-204648/XAB) **Oil-slick sizes and length of coastline affected: A literature survey and statistical analysis. Final report.** Ford, G.G. Minerals Management Service, Los Angeles, CA (USA). Pacific OCS Region. Oct 1985. 37p. (OCS/MMS–85/0105). Available from NTIS, PC A03/MF A01.

This report's objective was to prepare an historical and statistical analysis of the size of oil slicks at sea and the length of coastline affected by oil slicks. The report provides a statistical analysis of a compilation from published accounts of oil spills throughout the world. A total of 21 incidents which included descriptions of slick sizes, and 39 incidents which included description of the amount of coastline oiled were located in the literature.

44521 (PB–89-866347/XAB) **Oil spills: environmental effects. January 1977-July 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 205p. Available from NTISPC N01/MF N01.

Supersedes PB–87-863643.

This bibliography contains citations concerning environmental impacts from oil spills primarily resulting from ship wrecks and oil drilling and exploration. Oil spills in temperate, tropic, and arctic zones that affect fresh, estuary, and marine waters are included. Cleanup operations and priorities, computer modeling and simulation analysis, oil-spill investigations, and predicted movement of oil slicks in high-traffic shipping lanes are among the topics discussed. Microbial degradation of oils and testing of oil and oil dispersant toxicity to aquatic plant and animal life are considered. (This updated bibliography contains 369 citations, 39 of which are new entries to the previous edition.)

44522 (RER–092) **Guide to dispersant. Use decision making for oil spills in the Canadian southern Beaufort Sea.** Trudel, B.K.; Jessiman, B.J.; Ross, S.L.; Swiss, J.J. Ross (S.L.) Environmental Research Ltd., Ottawa, ON (Canada); Dome Petroleum Ltd., Calgary, AB (Canada). 1988. 413p. (MICROLOG–89-02399). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document provides a guide to be used by on-site decision makers in deciding whether or not to use chemical dispersants in the event of oil spills in the southern Beaufort Sea. The guide simplifies the decision making process by analyzing, in advance, many of the important considerations and presenting the results in a convenient form. In the event of a marine oil spill in the area, a decision regarding dispersant use can be derived by finding out whether the spilled oil is of a dispersable type, whether an effective dispersant operation can be mounted with the available equipment and material, and whether the use of dispersants will clearly reduce the overall environmental impact of the spill. Finding out these answers can be complicated by a number of variables including the type of spill, spill location and volume or discharge rate, wind direction, and the location and vulnerability of resources relative to the location of the spill decision making. The guide integrates the effects of these variables into the decision making by a step-by-step approach. A series of maps is provided which identifies the sensitivity of resources in each sector to treated or untreated spills. The sensitivities of species in each sector have been summarized in a series of tables. Detailed discussion is also provided on 22 key fish, waterfowl, and marine mammal species in the Beaufort ecosystem. For each species, information is provided on life history, habits, habitat utilization, and distribution, and on the contribution of these factors to the species vulnerability. 70 refs., 177 figs., 9 tabs.

44523 (SI-R–871208-3) **Mathematical model for estimation of oil injuries on birds.** Sandersen, E.; Mehlum, F.; Seip, K.L. Senter for Industriforskning, Oslo (Norway). Oct 1988. 90p. (In Norwegian). Order Number DE89914749/JAW. Available from NTIS (US Sales Only), PC A05.

A model for damage on birds from oil spills is developed and adapted to bird injuries in Northern Norway. The parametres in the model is determined for spills up to 10000 tons of oil and for the bird species: Common guillemot, kittiwake and eider duck. The model may be used on an IBM-AT. The program may be obtained from the Senter for Industriforskning and the Direktoratet for naturforvaltning. The report contains an user manual and an example. 15 figures, 17 tables.

0210 Legislation and Regulation

44524 (ERCB–D89-3) **Bonanza Oil and Gas Ltd., a unit of Poco Petroleums Ltd., application for a well licence, Altario field. Decision 89-3.** Energy Resources Conservation Board, Calgary, AB (Canada). [1989]. 22p. (CE–02758). Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Bonanza Oil & Gas applied for a license to drill a well near Altario, Alberta, for producing oil from the Bakken and gas from the Sparky production zones. A hearing was held to consider the issues raised by the application, including the impacts on native prairie from the well drilling and production facilities. Issues considered at the hearing related to the rights of the mineral and surface leases, the need for protection of native prairie habitat, subsurface geology and well target areas, vertical and directional drilling economics, future development options, and impacts on the land surface. It was concluded that prospects for oil and gas exist in the zones considered, and that up to four Bakken oil wells on one legal subdivision spacing might be needed. At the same time, it was agreed that current efforts by the present landowners of the well site to maintain maximum protection of native prairie by excluding mechanical access and controlling grazing should be continued to the optimum feasible degree. Considering all factors, the fairest treatment was felt to be the granting of the proposed well site location on the understanding that it could serve as a pad for drilling the initial and follow-up wells, but that stringent conditions should be imposed regarding the season for drilling access, site construction, soil stripping, land access and restoration, and placement of drilling and production facilities.

44525 (ERCB–IL89-8) **Proposed revisions to the modified proration plan.** Energy Resources Conservation Board, Calgary, AB (Canada). 1989. 14p. (CE–02771). Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

It is the general consensus in the Alberta oil industry that a formal contingency program must be available that would permit an orderly allocation of oil production to meet the needs of the marketplace. While the Market Demand (MD) System developed in the 1950s and 1960s was appropriate for its time, it is recognized that the System is inordinately complex and outdated to satisfy the current free market environment. Accordingly, the current MD System (Basic Proration Plan) will be discontinued as the back-up to the Modified Proration Plan (MPP), introduced in 1987 on a trial basis, and will be replaced by a system of pipeline prorationing. Under the revised MPP, production prorationing will be applied only to specific crude oil streams on specific feeder pipelines depending on the market for each stream. Individual production entities would be assigned a complaint level, to replace the existing initial production level. Any producer unable to market production equal to this level would be allowed to apply for the implementation of production prorationing. Under the revised system, each producer will be responsible for determining his own complaint level(s) as described in this document. 1 figs., 1 tab.

0220 Transport, Pipelines, and Handling

Refer also to citation(s) 44525

44526 (NEI-DK–192, pp. 9/1-9/16) **Development of an integrated pipeline management system (IPMS).** Svensson, T. (DHI-R and H Pipedata, Copenhagen (DK)); Larsen, L.C.; Hinstrup, P.I.; Nielsen, J. Aa. Industri- og Handelsstyrelsen, Copenhagen (Denmark). Formidlingsraadet. Jan 1989. (CONF-8709461–: Hearing on presentation of low cost contribution to hydrocarbon projects, 22-23 Sep 1987). In *Presentation of low cost contribution to hydrocarbon projects.* Order Number DE89914663/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Supply of hydrocarbons rely in many cases on the safe transport through submarine pipelines. Security of supply is maximized through intensive and costly Inspection, Maintenance and Repair (I,M and R) activities. The purpose of the IPMS project is to develop a computerbased information management system holding all information necessary for optimizing I,M and R activities and security of supply. New information technologies have initiated the developement of a complete new generation of data base management systems. The aim of the IPMS project is to apply this technology to offshore pipelining. The IPMS project was initiated in January 1986 and the project development work was completed in September 1987. Prototype testing is ongoing in the offices of Maersk Oil and Gas A/S in Esbjerg, Denmark. (author).

44527 (NEI-NO–69) **Flexible pipe technology.** Norsk Petroleumsforening, Oslo (Norway). 1986. 341p. (CONF-8609479–: Flexible pipe technology, 23-24 Sep 1986). Order Number DE89914774/JAW. Available from NTIS (US Sales Only), PC A15/MF A01.

The conference proceedings contain 12 papers. The topics covered are: Technology, products and offshore applications; Steel reinforced elastomer pipes - Design approach and performance characteristics; Flexible pipe installation techniques; Gullfaks "A" project; Retrieval and re-use. Four major examples worldwide; Flexible dynamic risers - state of the art; Dynamic response of flexible risers - problem areas and methods of analysis; Experience from flexible risen analysis; Practical aspects of design and operation of flexible flowlines; Some aspects of thermal insulation of flowlines and their relevance to flexible pipes. No separate abstracts were prepared.

44528 (NEI-NO–90, pp. 38) **Oseberg transport project. Experiences from the 1985 investigations.** Fritsvold, R.P. Norsk Hydro, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper concerns the Oseberg pipeline project dealing with the route investigations and shore approach planning for the pipeline from the Oseberg field to the land-based terminal at Sture in the neighbouring area of Bergen (Norway). The pipeline route passes the Norwegian Trench with a water depth of 360 m. The terminal consists of loading piers and oil storage facilities. 14 figures.

0230 Properties

Refer also to citation(s) 44476, 44548

44529 (DGMK–393) **Evaluation of approximation equations - approximation and extrapolation of pressure viscosity measuring of mineral oils.** Noack, G.; Bode, B. Technische Univ. Clausthal, Clausthal-Zellerfeld (Germany, F.R.). Inst. fuer Reibungstechnik und Maschinenkinetik; Deutsche Wissenschaftliche Gesellschaft fuer Erdoel, Erdgas und Kohle e.V., Hamburg (Germany, F.R.). Mar 1989. 90p. (In German). Available from Copy held by UB/TIB Hannover.

The viscosity measuring of liquids in the high pressure lab up to pressures of 10 000 bars show at least in the lower temperature range an S-shaped curve of pressure viscosity. This can definitely be attributed to the beginning phase transition of fluids from the liquid into the solid state. The results of investigations show that none of the commonly used approximation equations is suitable to describe the viscosity range under high pressure with beginning phase transition. Basing on the theories about 'free volume' of Cohen/Turnbull and Matheson this report is a first attempt to describe the pressure dependent fluidity by means of a simple model in the liquid phase as well as in the phase of beginning transition of fluid from the liquid into the solid state. A variety of liquids prove the practicability of this model. The density measurements show depending on the liquid used a more or less characteristic discontinuity in the phase transition state which is of basic importance for the fluidity of these liquids. The extrapolation of viscosity has limited applicability, measuring of pressure viscosity is indispensable. (orig.) With 60 figs.

44530 (IKU-R–02.0786.00/03/88) **Chemical dispersability testing of fresh and weathered crude oils. DIWO report no. 3.** Daling, P.S.; Almaas, I.K.; Bakken, O.; Brandvik, P.J.; Aareskjold, K. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Jul 1988. 67p. Order Number DE89914753/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

An extensive laboratory study on the "relative" dispersability of fresh and weathered oils produced or transported in Norwegian coastal waters has been performed. The aims of this study has been: (1)To correlate the effectiveness results obtained by three laboratory test methods (with two dispersants and at a two temperature conditions) (2) To define the relationship between the changes in dispersant effectiveness and the changes in an oil's physicochemical properties due to weathering (evaporation, photolysis and w/o-emulsification). The study clearly demonstrates that the type of crude and especially the weathering properties of the crudes are essential for the performance of a dispersant at sea. 45 figures, 14 tables.

44531 (IKU-R–02.0786.00/04/88) **W/O-emulsion formation and W/O-emulsion stability testing. DIWO report no. 4.** Daling, P.S.; Brandvik, P.J. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Aug 1988. 122p. Order Number DE89914754/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

This activity (activity II in task 3) of the DIWO project consists of an extensive laboratory study on the w/o-emulsion formation tendency and w/o-emulsion stability properties on Gullfaks crude, Statfjord crude and Arabian Heavy crude. The aims of this laboratory work were to study the following: the rate of w/o-emulsion formation, the maximum water uptake ability, the w/o-emulsion stability, the w/o-emulsion breaking effectiveness of Finasol OSR-5, the w/o-emulsion inhibition effectiveness of Finasol OSR-5, as a

function of type of crude, degree of weathering (evaporation, photolysis), temperature and energy conditions. 62 tables, 85 figures.

44532 (IKU-R–34.2716.00/01/88) **Sampling of reservoir fluids.** Lindeberg, E. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Oct 1988. 28p. (In Norwegian). Order Number DE89914745/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report views the common sampling methods for hydrocarbon fluids critically. Emphasis is put on surface sampling and the sources of the substantial uncertainties attached to such samples. The problems with using mercury in sampling is discussed as well as the use of mercury compared to mercury-free methods. The mercury- free equipment of today is described and evaluated critically. 1 table, 2 drawings, 10 references.

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Refer also to citation(s) 44507

44533 Residual fuel oil stability and compatibility studies. Por, N. (Oil Refineries Ltd., Haifa (Israel)); Brauch, R.; Brodsky, N.; Diamant, R. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Following the introductory study on residual fuel oil stability properties and compatibilities reported at the 2nd International Conference on Long Term Storage Stabilities of Liquid Fuels which took place in San Antonio, Texas in July 1986, further work regarding this subject has been carried out at the Oil Refineries Ltd. Research Laboratory in Haifa. The present work covers an investigation of the relation between the chemical characteristics of residual fuels and their stability and compatibility properties, with emphasis given to the mechanisms of the processes associated with degradation product formation during storage and use. Data reported in this work facilitate the operation of visbreaker processes, not only with respect to their severities but also regarding the visbreaker technologies involved; this study has been made possible by using data concerning intermediate as well as final samples of the products obtained in the recently employed soaker operations and comparing them with similar samples obtained in the formerly used conventional visbreaking process. All the samples have been subjected to conventional as well as specially devised tests and laboratory processes. Data obtained show the advantages of using the asphaltene peptization state phenomenon as an indication of the stability and compatibility properties of the residual fuels; this can also be useful as a controlling parameter for the desired optimized severity of visbreaker operations.

44534 Prediction of storage stability and compatibility of residual fuel oils. Rovesti, W.C. (Electric Power Research Institute, Palo Alto, CA (USA)); Anderson, R.P. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The occurrence of problems in the storage and handling of residual fuel oils in the US Electric Utility Industry has increased with the increased use of lower quality crudes and with the increased severity of refining which refiners have used to convert residual materials to distillate products. Conventional residual fuel oil specifications and test methods were found to be inadequate to predict or prevent problems due to instability (tendency to form sediment on storage or thermal stress or to undergo other changes such as changes in viscosity) or to incompatibility (tendency to form sediment on blending with a diluent or with another fuel). In the 2nd International Conference on Long-Term Storage Stabilities of Liquid Fuels, the authors reported on simple rapid test methods which showed promise for the prediction of stability and compatibility characteristics of residual fuels. These tests have been further evaluated. The results of the rapid test methods correlate with baseline laboratory tests for stability and compatibility. The more promising predictive tests are undergoing implementation in selected electric utility laboratories as part of an overall program to relate the test results to actual plant performance relative to heavy fuel oil blending, storage and handling. This report discusses some of the initial results of this field evaluation of the rapid test methods.

44535 Coating systems for the internal lining of methanol and methanol-containing fuel storage tanks. Vorster, O.C. (Technikon Pretoria (South Africa)). pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The author outlines the properties desirable in coating systems for concrete and steel tanks used to store petroleum fuels, methanol, and blends. Results of the tests on a series of coatings based upon different binders and on a three-coat system combining desirable properties are reported. It concluded that the three-coat system should give satisfactory performance.

44536 Effects of storage on the stability of residual fuel oil. Lewis, C.P.G. (Koninklijke/Shell-Laboratorium, Amsterdam (Netherlands)); de Jonge, F. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Sludge formation will not take place if the oil phase has sufficient aromaticity to prevent the asphaltenes from flocculating. Asphaltenes are large, complex and highly aromatic molecules that can be distinguished from coke or other contaminants by their solubility in highly aromatic solvents. The stability is governed by a balancing mechanism, which depends on the chemical nature of the asphaltenic molecules present and of the oil surrounding them. This balance is described in terms of the required aromaticity for the asphaltene molecules to remain in solution, and the available aromaticity (peptizing power) of the oil phase. This paper presents the results of investigations into the effects of storage on stability. It has been found that the stability of a stable residual fuel composed of normal refinery streams does not deteriorate perceptibly during storage for two years at temperatures up to 75°C. However, a significant change in the viscosity and in the asphaltenes content is observed as a result of the conversion of resins into newly formed (peptized) asphaltenes due to oxidation/polymerization reactions. The rate of change depends markedly on the scale and temperature of storage. On a laboratory scale and at elevated temperature (75°C) the increase is significantly more pronounced than in large tanks at more realistic storage temperatures (up to 50°C). A marginally unstable fuel clearly shows additional flocculation of asphaltenes, the extent of which increases with storage temperature. The significant role of oxygen in the flocculation process has been demonstrated, i.e. in its absence flocculation is strongly delayed. The possibility of flocculation inhibition by chemical compounds is discussed. The state of the art of detection of flocculated asphaltenes in opaque media is reviewed. For field measurements a test kit has been developed.

44537 Influence of lubricating oils on the colloidal stability reserve of residual fuel oils. Pogonowska-Fabriek, W.; Holbrook, P. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The stability reserve of some 20 fuel oil/lubricating oil blends is assessed as hot filtration solids content - straight and following thermal and chemical acceleration. The predominantly aliphatic lubricating oils considerably reduced the stability reserve of some fuels even at low concentrations C-14 NMR aromaticity measurements on the fuels and lubricating oils are also reported, and the authors suggest that these may serve as a tool to assist in the prediction of residual fuel oil stability reserve.

44538 Quality of fuels formed by severe hydrotreatment of vacuum residues. Hara, T. (National Univ., Yokohama (Japan));

Yanagida, K.; Okano, A. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Heteroatom functionalities are quantitatively analyzed for vacuum residues of various petroleum crude oil. Distribution of acidic NH group and OH group among vacuum residues has been analyzed by measuring infrared spectrum in very dilute solution using 2 cm KBr liquid cells. The structure and nature of such functionalities have been characterized for petroleum vacuum residues, compared with those involved in other hydrocarbon resources such as oil sand bitumen, shale oil, coal liquefaction products and coal pyrolysis tar. Structural change of such polar functionalities caused by various conditions of hydroprocessing has been analyzed in the hydrotreatment of vacuum residues derived from various resources. Petroleum vacuum residue was severely hydroprocessed in various reaction conditions (395-420°C, LHSV = 0.20 h^{-1}, H_2 pressure = 130 kg/cm^2, feed rate = 150 cc/h) in the presence of a hydrodesulfurization catalyst by a two-stage microreactor. The 538°C+ conversion reached to 57% at the most severe reaction condition. The sludge formed during the hydroprocessing as well as heavy ends (350°C+ and 538°C+) produced by the hydroprocessing were structurally characterized. The storage stability of the products were also discussed.

44539 Biodegradation of stored heavy fuel oil with production of methane in unlined rock caverns. Roffey, R. (Sweden Defense Research Establishment, Umea); Edlund, A. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

During storage of heavy fuel oil on a waterbed in unlined rock caverns for long periods of time problems with degradation of oil and production of methane gas have been observed. In order to understand the factors responsible for the microbial methane production and to find methods to inhibit the methanogenic bacteria a study was undertaken. Chemical and microbiological investigations at two storage plants where problems had occurred showed that anaerobic conditions existed in the bedwater and that a complex microbial community was present. The methane production was calculated to be 2-37 g/day, m^3 bedwater. to study methods to inhibit the methanogenic activity laboratory model systems were used. Four methods were evaluated which were increasing the oxygen level in the bedwater, increasing the pH to 9, using a biocide an isothiazolone compound or addition of nitrate. It was found that only nitrate addition gave a satisfactory inhibition at a concentration of 0.5 g/l in the water.

44540 Studies on a U.S. Military approved fuel preservative and stabilizer. Klein, F.T. (ANGUS Chemie GmbH, Ibbenbueren (West Germany)). pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The characteristics and efficacy of a nitroalkyl morpholines biocide, approved as the biocidal component required by U.S. Specification MIL-S-53021, are reported and discussed.

44541 Survey of the microbial contamination level of some Finnish fuel storage systems (24). Carlson, P. (Univ. of Helsinki (Finland)); Niemelae, S.; Tenhunen, E. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The aim of the project was to estimate the degree of microbial contamination of jet fuel and light heating oil in both long and short term storage in Finland. The nine storage systems studied included both rock caverns and above-ground and subsurface steel tanks. Samples were taken biannually. Sampling methods were developed. Certain physical and chemical factors relevant to the appearance of microbiological problems were analyzed, too. No corrosiveness was found in the fuel samples studied in the standard silver and copper corrosiveness tests, nor when a more sensitive Swedish method was applied, utilizing piezoelectric crystals. No water bottoms were found in the jet fuel storage systems and few microbes were found in the fuel itself. In the light heating oil water bottoms the microbial counts were higher. Cladosporium resinae, a common fuel contaminant, was absent from the two rock caverns studied. The constantly low temperature in these tends to select an aerobic flora consisting chiefly of cold tolerant gram-negative rods, including some psychrophilic forms. Many of the bacteria are pseudomonads, which are especially difficult to eradicate with biocides, because resistant mutants are likely to develop quickly. The water bottoms of the fuel tanks and the bed waters of the caverns, as well as the fuels, were analyzed for C_2-C_{10} saturated aliphatic straight chain carboxylic acids. These compounds are likely to accumulate in fuel-water systems, where microbial growth has taken place. They were found in low concentrations usually not exceeding those of fresh products and, with a few exceptions, are not thought to be of microbiological origin.

44542 Use of BNPD to control microbial growth in diesel fuel systems. Elsmore, R.; Guthrie, W.G. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The compound 2-bromo-2-nitropropane-1,3-diol (BNPD), already widely used as an antimicrobial in pharmaceuticals, cosmetics, etc., was assessed for possible application as a fuel biocide. The compound dissolved into distillate fuels in the presence of a cosolvent such as methoxyethanol, but partitioned strongly into the aqueous phase. Biocidal activity against fungi, aerobic and sulfate-reducing bacteria in fuel/was systems was quantified.

44543 Biological monitoring and control strategy for large diesel fuel storage facilities. Reynders, M.P. (Sastech, Sasolburg (South Africa)); Stegmann, P. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Large diesel fuel storage containers are subject to microbiological related problems, i.e. biofouling biocorrosion and degradation of the fuel. Micro-organisms are able to use diesel fuel as carbon and energy source. Four fungi and nineteen bacteria species were isolated from contaminated diesel fuel and blocked filters, all proved to be primary users of diesel fuel. Two bacteria species specifically were found to be the most common cause of microbial induced filter blockages due to their ability to form spores and to inhibit the growth of other hydrocarbon utilizing micro-organisms. It was shown that one of these was capable of excreting a gummy substance which was able to rapidly block fuel filters. Factors which contribute to the development of a biological treatment strategy are the presence of water with readily available nutrients and carbon source within the tank, cost of treatment and operational considerations. The use of a water soluble biocide treatment program in these storage facilities has proved successful and has prevented the establishment of a food chain which can cause the blockage of fuel filters, the corrosion of containers, pipelines and meters and the degradation of the fuel.

44544 Microbiological test methods for fuels in the laboratory and on site. Hill, E.C. (ECHA Microbiology Ltd., Cardiff (England)); Hill, G.C.; Robbins, D.A. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The various methods to test for microbiological contamination in aqueous and fuel phases, both in the laboratory and on-site, are discussed and many potential pitfalls pointed out. In particular, the need is emphasized to neutralize any biocide present in the sample

before growth assay techniques are employed. Methods of extraction of microorganisms from the fuel phase into water are discussed and a novel strategy involving the use of flocculant is described.

44545 Biocides for microbiological contamination control in naval distillate fuel. Morchat, R.M. (Defense Research Establishment Atlantic, Halifax, Nova Scotia (Canada)); Hebda, A.J.; Jones, G.M.; Brown, R.G. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Microbiological contamination (MBC) in naval fuels can cause serious operational problems, particularly if coalescers are used for water removal and if the fuel is to be used in gas turbine engines with their intricate fuel control units which are easily blocked. In order to identify a biocide which could be used to treat MBC problems in fuel on ships, five commercial biocides have been evaluated. These biocides include compounds based on benzimidazoles, pyridinethiol-1-oxide, dioxaborinanes, morpholines and isothiazolones. The degree of susceptibility of microorganisms, in naval distillate fuel, to the specific biocides was evaluated. Pure cultures of Cladosporium resinae, Yarrowia lipolytica, Pseudomonas aeruginosa and mixed cultures in fuel/water mixtures were treated with the manufacturers recommended concentrations of the biocides. Results indicated that none of the biocides tested were able to inhibit all of the culture types, under the experimental conditions. Reinoculation trials were carried out on select biocides using pure cultures of C. resinae. Also, bottle scale trials involving the removal and replacement of the water layers were carried out to imitate the use of water displacement-type fuel systems.

44546 Evaluation and comparison of microbial growth in distillate fuels. Miller-David, P.J. (Research Laboratories, Inc., Fort Wayne, IN (USA)); Pipenger, G.G. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Microbial contamination of fuel tanks and systems has been blamed for fuel system corrosion, filter and line plugging, and fuel degradation. Of the fuel samples in this evaluation, bacterial growth has been isolated from as many as 56% of stored fuel systems in the US. Since most storage tanks were underground and maintained a relatively constant temperature year-round, microbial proliferation was neither regional nor seasonal. Although microbial growth in fuel systems is an area of concern involving both users and suppliers of distillate fuels, this study limits its scope primarily to users of distillate fuel and further attempts to categorize microbial isolates of fuel systems and their deleterious effects to fuel by: frequency of appearance; colony forming units per milliliter quantitated; amount of growth byproduct generated, and physical appearance of the water, fuel, and interfacial phases. Samples of fuel were collected from a twenty-three state geographical area east of a line from New Mexico to the Dakotas. The states sampled most heavily were Indiana, Ohio, Michigan, Kentucky, Illinois, Tennessee, New Jersey, Florida, and Texas. This study limits its attention to aerobic organisms, initially cultured and isolated on Tryptone, Yeast, Dextrose agar, then subcultured to appropriate media for identification. Inoculation, culturing, identification and isolation were performed according to guidelines established for clinical pathogens. Statistical evaluations were used to compare specific organisms isolated along with amount of colony forming units generated to amounts of growth by-products, physical appearance of the fuel, and physical appearance of the water phase in samples collected. By isolating specific organisms from fuel which have been statistically shown to affect the condition of stored distillates, the fuel user can select treatment methods most effective against those organisms.

44547 Nuclear magnetic resonance techniques for predicting thermal stability of jet and diesel fuel. Russell, J.A. (Southwest Research Institute, San Antonio, TX (USA)); Bailey, B.K.; Buckingham, J.P. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

A wide variety of distillate hydrocarbon fuels were characterized as to thermal stability breakpoint (JFTOT, ASTM D 3241) and chemical structure parameters directly measurable by Proton Nuclear Magnetic Resonance (^{1}H NMR). Materials included coal-derived distillates subjected to three levels of hydrotreating severity, specification-quality military diesel and jet fuels, special high-energy density and high-thermal stability jet fuels, and pure hydrocarbons. Regression modeling resulted in one general model and three-submodels for three distinct temperature regimes. The coefficients of the NMR terms appearing in these equations have provided valuable information on molecular structure factors which enhance or degrade thermal stability.

44548 Old and new ways of using the JFTOT for aviation fuel stability research. Datschefski, G. (Esso Research Centre, Abingdon (England)). pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The Jet Fuel Thermal Oxidation Tester (JFTOT) is normally operated under standard conditions required by international specifications for qualification of production batches of jet fuel. Because the test can discriminate between fuels of poor and good high temperature stabilities, it has a valuable role in its present form for quality assurance of fuels. However, it can also be used under a wider range of operating conditions for research into high temperature thermal stability behavior of aviation fuels. Some typical research investigations are reviewed in the paper to illustrate this point. When used in the research mode, several shortcomings of the JFTOT become evident, particularly in the areas of tube deposit assessment and tube surface metallurgy. Improvements are proposed to overcome these shortcomings, e.g. measuring tube deposits quantitatively by carbon burnoff, or by recently developed methods utilizing light interferometry and breakdown of dielectric potential. JFTOT breakpoint temperature is a very important concept for establishing the level of fuel thermal stability quality, and this is discussed in detail. Some single test predictive methods for measuring breakpoint temperature are outlined, which are aimed at shortening the usual lengthy multi-test determination of this parameter.

44549 Comparison of JFTOT heater tube deposit rating methods for the evaluation of fuel thermal stability. Morris, R.E. (Naval Research Lab., Washington, DC (USA)); Hazlett, R.N.; McIlvaine, C.L. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The quantification of deposits formed on heated metal surfaces is used as one measure of thermal stability by the JFTOT procedure. Empirical methods widely employed entail either visual comparisons or measurements of reflected light (TDR), both of which are sensitive to deposit color. The authors have found that measurements of total carbon content by combustion are more reliable and have compared a number of deposits formed on stainless steel JFTOT heater tubes by the TDR and combustion methods. In addition, two novel techniques based on measurements of dielectric strength and the interference effect produced upon reflectance of monochromatic light have been examined. It was found that the dielectric and interference methods correlated well with the combustion analyses and each other, while the TDR often yielded misleading results. The correlations between the various methods will be discussed in addition to the consequences of method choice on the interpretation of experimental data.

44550 Thermal stability measurements using the fiber optic modified jet fuel thermal oxidation tester. Kamin, R.A. (Naval Air Propulsion Center, Trenton, NJ (USA)); Nowack, C.J.; Darrah, S. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

An experimental study was conducted to evaluate the use of fiber optics to measure Jet Fuel Thermal Oxidation Tester (JFTOT) tube deposition. Eight fiber optic probes, connected to a data acquisition system, were embedded into a standard JFTOT tube housing. This modification, based on the theory of light interference phenomena, provided real time quantitative measurements (in microns) of the deposit thickness formed on the tube during testing. A single probe off-line fiber optic unit was also constructed to make deposit thickness measurements spatially along the tube at the completion of the test. Six fuels, with breakpoint temperatures ranging from 216°C (420°F) to 263°c (505°F), were tested over a tube temperature range of 204°C (400°F) to 316°C (600°F). Arrhenius plots of the data allowed a comparison of the fuel deposition rates over a range of temperatures above and below the fuels respective breakpoint temperatures. Interpretation of the initial results indicates that the fiber optic modification enhances the capabilities of the JFTOT as a research tool.

44551 Role of alkylperoxy and alkyl radicals in fuel deposit and gum formation. Reddy, K.T. (Drexel Univ., Philadelphia, PA (USA)); Cernansky, N.P.; Cohen, R.S. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The thermal stability characteristics of n-dodecane and n-dodecane plus heteroatomic species were studied after aerating the fuels and stressing them on a modified Jet Fuel Thermal Oxidation Tester (JFTOT) facility. Fuel degradation mechanism(s) were hypothesized, based on the quantification and identification of the soluble degradation products using Gas Chromatography and Mass Spectrometric techniques. the mechanism suggests that in the autooxidations regime ($T \leq 300C$), the alkylperoxy ($RO_2^{\bullet}$) radical reactions appear to dominate the alkyl ($R^{\bullet}$) radical reactions. Conversely, in the intermediate temperature regime ($300 \leq T \leq 400C$), the $R^{\bullet}$ radical reactions appear to dominate the $RO_2^{\bullet}$ reactions. The predictions of the fuel degradation mechanism were compared with actual fuel derived deposits and gums. Data from similar JFTOT experiments performed at the Naval Research Laboratory and from flask oxidation studies conducted at Stanford Research Institute were used to test the validity of the hypothesized mechanism. The data correlation showed that the hypothesized fuel degradation mechanism is valid. Thus, if the $RO_2^{\bullet}$ and $R^{\bullet}$ can be suitably scavenged in the appropriate temperature regimes using anti-oxidants, inhibitors, radical scavengers, etc., it may be possible to inhibit fuel degradation.

44552 Influences exerted by selected stabilizer additives on the thermal stability of jet fuel. Morris, R.E. (Naval Research Laboratory, Washington, DC (USA)); Hazlett, R.N.; McIlvaine, C.L. III. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The use of additives to improve the ambient storage stability of aviation fuels has created the need to characterize the influences exerted by these additives at the elevated temperatures of an aircraft fuel system. The behavior of several antioxidant compound types considered representative of those commonly used were examined during thermal stress in a modified JFTOT apparatus. The neat compounds 2,6-di-t-butyl-4-methylphenol and 2,4-diisopropylphenylenediamine in addition to a tertiary amine, were blended into Jet A at 24 mg/L. A metal deactivator, N,N'-disalicylidine-1,2-diaminopropane was added at 5.8 mg/L as the pure compound and from a multifunctional additive package which contained both the metal deactivator and a tertiary amine, added at 24 mg/L. From experiments conducted with stainless steel heater tubes at temperatures from 200 to 310°C, measurements of heater tube deposits, particulate formation, oxygen consumption and peroxidation were obtained. All the additives reduced the quantities of heater tube deposits formed at 260°c, compared to the neat fuel. At higher temperatures, the effects of the additives ranged from innocuous to deleterious, with the exception of the metal deactivator, which afforded substantial reductions in insoluble products at temperatures up to at least 310°C. The phenylenediamine was the most effective in reducing maximum peroxide concentrations, but this reduction was accompanied by increases in insoluble products.

44553 Further studies on the effects of polar compounds on the thermal stability of jet fuel. Clark, R.H. (Shell Research Ltd., Chester (England)); Smith, L. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The influence of polar compounds on the high temperature degradation mechanism of jet fuel has been studied using a number of experimental techniques. The deposition characteristics of the fuel were assessed by the Jet Fuel Thermal Oxidation Tester (JFTOT), while a flask oxidation test was used to probe the initial stages, that is liquid phase oxidation. The results of these tests have given an indication as to where polar compounds act within the overall degradation mechanism. The studies employed a dual strategy using both polar compounds and extracts obtained from commercial jet fuels. The model compounds encompassed sulfur, nitrogen and acidic species, while the use of ion exchange chromatography provided acidic extracts from commercial jet fuels. The work examined not only the individual effect of each compound class, but also their pairwise interactions. From these studies, the authors have developed an improved means of predicting, from compositional information, fuel degradation rates in service.

44554 Role of a metal deactivator in improving the thermal stability of aviation kerosenes. Clark, R.H. (Shell Research Ltd., Chester (England)). pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Under the high temperatures encountered in certain parts of a gas turbine fuel system, aviation kerosene undergoes thermal degradation to form deposits. Ultimately, these will impair the operation of the engine and require the premature servicing of the affected components. To ensure adequate thermal stability, fuels are certified by testing in the Jet Fuel Thermal oxidation Tester (JFTOT). Kerosenes which fail this test must either be discarded to a lower value pool, or may sometimes be upgraded by the use of an approved stability enhanced agent. In the case of civil fuels, the sole such approved additive is N,N'-disalicylidene 1,2-propane diamine, which functions as a metal deactivator and is commonly known as MDA. This paper describes studies conducted to identify the mechanisms by which MDA acts. The experimental techniques employed were as follows; a flask oxidation test to investigate the effect of MDA on the oxidation mechanism and thence to establish a binding ratio between MDA and dissolved copper; the JFTOT and thirdly fuel system simulators designed to examine oil-cooler lacquering and injector feed-arm fouling. The results confirm that MDA acts to chelate dissolved metals in a near 1:1 mole ratio and thereby reduce their catalytic activity towards radical initiation; as such, therefore, they are highly effective at reducing fuel oxidation and thence deposition. At the same time, the JFTOT and rig tests show that MDA produces a beneficial effect even for fuels containing little or no dissolved catalytic metals. This phenomena is attributed to a second beneficial mechanism, namely, surface passivation. When compared to more realistic rigs, the JFTOT appears to be over-responsive to this passivating aspects of MDA's action. The results are discussed in terms of the criteria for the appropriate application of MDA.

44555 Jet fuel instability: organo-sulfur hydroperoxide interactions. Mushrush, G.W. (Naval Research Lab., Washington, DC (USA)); Hazlett, R.N.; Hardy, D.R.; Watkins, J.M. Jr. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The role of organosulfur compounds and hydroperoxides on the oxidative stability of middle distillate fuels is not well understood.

Differences in fuel composition, reaction surface, hydroperoxide concentration, dissolved oxygen and reaction temperature all contribute to the variation in observed results. In an effort to clarify this situation, the authors have examined the t-butyl hydroperoxide liquid phase oxidation of hexyl sulfide, dodecyl thiol, hexyl disulfide, substituted thiophenes, and thiophenol in benzene and a model fuel, tetradecane. The relationship between organo-sulfur compounds and the peroxidation of JP-5 have been studied under conditions of accelerated storage.

44556 Hydroperoxide formation and reactivity in jet fuels. Watkins, J.M. Jr. (GEO-Centers, Inc., Fort Washington, MD (USA)); Mushrush, G.W.; Hazlett, R.N.; Hardy, D.R. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Hydroperoxides in jet fuels attack elastomers in aircraft fuel systems resulting in leaks of in operation of fuel controls. Examination of fuels refined by different processes has indicated that significantly higher peroxide concentrations exist in fuels which have been severely hydrotreated. It is believed that hydrogenation is responsible for removing natural inhibitors, including sulfur compounds, to peroxide formation. To test this thesis, the relationship between aryl thiols and peroxidation of jet fuels was examined using model dopant studies under 65°c accelerated storage conditions. Samples were analyzed on a weekly basis for peroxides and sulfur compound concentration. Thiophenol demonstrated effectiveness in reducing and/or controlling peroxide concentration for an equivalent ambient storage time of approximately two years.

44557 Chemistry of antioxidant additive depletion in jet fuels. Sutterfield, F.D. (IIT Research Institute, Bartlesville, OK (USA)); Brinkman, D.W.; Bhan, O.K.; Green, J.B.; Goetzinger, J.W.; Sturm, G.P. Jr.; Speck, G.; Turner, L. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Fresh samples from two West Coast (USA) refinery hydrocracker streams with boiling ranges similar to JP-5 fuel were aged at temperatures of 60° and 80°C heat and after blending with two hindered phenol-type antioxidants. Additive concentration, peroxide number, color, filterable sediment, and adherent sediment were determined periodically. Also, fresh and aged samples of the two hydrocracker streams without additive and sediments produced by the aged samples were analyzed in detail by gas chromatography/mass spectrometry, probe microdistillation/high resolution mass spectrometry, and infrared spectroscopy. The data from the aging experiments indicated an initial induction period followed by a period of rapid depletion of antioxidant and an increase in peroxide. This was followed by a final period of decreasing peroxide content, increasing color formation, and increasing filterable and adherent sediment formation. The additives were effective in delaying the onset of peroxide, color, and sediment formation. Results from detailed analyses of the additive-free fresh and aged fuels and sediments indicated that the gums or sediments apparently result primarily from oxidation of alkyl-substituted indans, tetralins, indenes, dihydronaphthalenes, naphthalenes, and benzenes. In the next phase of the study, corresponding samples from the fuels with antioxidants will be analyzed and the results compared with those reported here. Overall results to date support a free radical chain oxidation mechanism as a primary mechanism operative in formation of sediment in these two fuels. The presence of dimers is consistent with mechanisms involving the condensation of oxidation products and the coupling of substrates by peroxides.

44558 Effect of peroxide content on the thermal stability of hydrocracked aviation fuel. Turner, L.M. (Naval Air Propulsion Center, Trenton, NJ (USA)); Kamin, R.A.; Nowack, C.J.; Speck, G.E. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Extensive research efforts have been conducted to study the chemistry of both storage and thermal oxidation stability but very little work has been done to relate these two areas. Recent findings however have indicated that there may be a relationship between the two stability temperature regimes based upon the similarity in chemical composition of the gum deposits formed during accelerated storage stability tests and the deposits obtained by thermal stressing in the Jet Fuel Thermal Oxidation Tester (JFTOT). Accelerated storage stability tests were conducted on two hydrocracked aviation fuels with and without antioxidant. Samples were analyzed for peroxide number, total acid, existent gum and thermal oxidation stability (JFTOT) regularly over a period of 16 weeks. A link was developed relating the increase in peroxide concentration of the fuel during storage with the increase of deposition in the JFTOT.

44559 Research on problems with the use of current fuel system icing inhibitors in jet fuels. Brinkman, D.W. (IIT Research Institute, Bartlesville, OK (USA)); Whisman, M.L.; Stirling, K.Q.; French, C.; Carley, W.; Dogrul, H. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). DOE Contract FC22-83FE60149. From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The use of fuel system icing inhibitors (FSII) in military jet fuels is outlined. Strategies for the removal of glycol ether FSII's from tank water bottoms before disposal are discussed. It is concluded that the most desirable option would be to avoid the generation of such contaminated water by delaying the addition of FSII to the fuel until it is about to be used.

44560 Stability properties of gasoline - alcohol blends. Por, N. (Oil Refineries Ltd., Haifa (Israel)). pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The lead phase down for motor gasolines resulted in a search for alternative octane boosters, some alcohols and ethers being the most favored candidates. The advantages and disadvantages of each of the oxygenates have been extensively studied, but the effect of oxygenates on the stability properties and long term storage stability of motor gasolines has been neglected. This paper summarizes the work done on the effect of some alcohols and ethers on degradation product formation in motor gasolines containing oxygenates. Following are some specific points which have been investigated in the present work: effect of oxygenates on the conventional stability estimates and on stability properties of different types of gasolines has been examined; a reduction of methanol concentration has been noted during storage of some motor gasolines containing methanol, especially in case of catalytically cracked gasolines. It has been investigated whether this phenomenon is associated with formation of ethers due to a reaction of methanol with olefins present in some severely cracked stocks or whether this is due to common phase separation; the effect of peroxy radicals in gasolines containing alcohols on the behavior of gasolines in storage and in use, such as formation of gumlike substances in inlet manifold systems of car engines, has been studied and is described in this paper; the mechanisms associated with degradation products formation in the various types of gasolines containing alcohols have also been studied from the point of view of reactions of free RO· or HO· radicals, or peroxy radicals (ROO·), with alcohols to form either degradation products or inducing oxidation reactions of the alcohols.

44561 Evaluation of motor gasoline stability. Morris, D.L. (Southwest Research Institute, San Antonio, TX (USA)); Bowden, J.N.; Stavinoha, L.L.; LePera, M.E. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

This paper presents current results of an on-going storage program whose primary goal is the development of improved methods for evaluating motor gasoline stability. Several existing and potential predictive tests were applied to both individual refinery components of gasoline, selected laboratory blends, and commercial gasolines for which ASTM D 525 induction periods ranged from 75 to > 5000 minutes. Darkroom storage was commenced at 43°C, 54°C, and ambient temperatures, for varying periods which will ultimately reach 4 years. Results to date confirm the findings of earlier researchers that ASTM D 525 is not viable as a predictive device by virtue of a low coefficient of determination between induction period and gum formed in storage at 43°C for periods up to 1 year. It is recognized, however, that ASTM D 525 is not likely to be abandoned as a specification stability test. Based upon the data generated to date under the four phases of this storage stability program including supporting data obtained from literature sources and current surveillance information on both military and industry practices, the method to be adopted for evaluating stability of commercial/military motor gasoline will consist of the modified ASTM D 873 Method using a 6-hour aging existent gum maximum limit of 20 mg/100 mL. The ability of this test to distinguish between stable and unstable low induction period fuels and/or components is discussed. In evaluating the individual potential gasoline components, a pyrolysis naphtha was shown to be generally an order of magnitude less stable than all other streams, and coker naphtha was shown to possess poor stability characteristics. LCC and HCC naphthas which make up the bulk of unleaded gasoline have lower stability than the remaining components. Reformate showed definite acceleration of deterioration during storage.

44562 Storage stability of aviation gasoline. Dekel, R. pp. 398 of Third international conference on stability and handling of liquid fuels. Conference proceedings. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Aviation gasoline specifications include accelerated aging tests with the intention to forecast in advance the storage life of the fuel and to ensure its stability for a reasonable period of time (1-2 years). The problematic question in this matter is for how long the fuel would be suitable for use if it is stored under adverse and unusual conditions and how the deterioration, if any, would influence the engine performance. The purpose of this study is to find the answer to these questions when the storage conditions are set in advance. Aviation gasoline according to MIL-G-5572 grade 100/130 with and without 5% lubricating/preservative oil are stored under regular and severe conditions in two kinds of containers: (1) 200 liters steel drums (2) 2 liters polyethylene bags. A test program for the different samples include gasoline specification properties, analytical methods to record possible chemical changes in the gasoline and functional tests. Parallelally, a two stroke cycle engine will be run with the fuels under test and it's performance recorded and correlated against laboratory test data. At each stage of the study the test results would be compared with the starting properties and chemical composition of the fuel. Finally the data would be statistically elaborated in order to establish the influence of the different parameters and the expected stability of the gasoline under specified storage conditions.

44563 Evaluation of commercial stability additives for naval distillate fuel. Hardy, D.R. (Naval Research Lab., Washington, DC (USA)); Beal, E.J.; Hazlett, R.N.; Burnett, J.C. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

This paper summarizes the effectiveness of nine commercial stabilizer additives in nine freshly refined fuels tested under a wide variety of test conditions. The tests included bottle tests between 43 and 80°C, ASTM D2274 and oxygen overpressure tests between 43 and 90°C. In addition to these gravimetric tests, some evaluation of additive effectiveness by a light scattering technique were made. This work emphasized the usefulness of additives added within 24 hours of fuel production. The control fuels exhibited a wide range of storage instability and were selected from US refineries utilizing a wide range of crude sources and processing. The fuels contained a range of catalytically cracked stock from less than 10% up to 40%. The results of the accelerated storage stability tests will be discussed. Taken as a whole, it is possible to identify several of the commercial additives as routinely effective and the bulk of the remainder as being innocuous at the concentration range studied in this work (24 to 50 mg/liter). In addition to the additives' effect on storage stability, their effects on other selected fuel properties will also be discussed.

44564 Distillate fuel stabilisation in a major European refinery. Mabley, P.B. (Ethyl Petroleum Additives Ltd., Bracknell (England)); Wallace, G.M. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

This paper illustrates how a complex European conversion refinery was able to maximize distillate production through the use of a specifically designed multi-functional stabilizer package. The first section of the paper deals with the profile of the Refinery in terms of operating capacity and processing units available. The economic drive to increase conversion products in the middle distillate pool is discussed. This increase was achieved by producing fuel closer to the required specification in terms of sulfur and cetane number. Key stability test requirements and performance parameters which this Refinery had to meet are then detailed. These included short term thermal and oxidative stability tests commonly employed in quality control applications and long term storage trials used to ensure good field performance. Latterly the approach to develop a multifunctional distillate stabilizer package specifically to meet the severe refinery requirement is described. Test data from the use of this package in the variety of stability test parameters is related. These results showed that balanced multifunctional additive packages added to fresh high severity conversion streams inhibit color degradation and sediment formation. This benefit allowed the refiner to optimize distillate production which was previously not possible due to constraints on the hydro-processing route. Field experience including engine testing has shown excellent correlation with the results from the initial study.

44565 Middle distillates stability: composition and additive utilization effects on their aging at different temperatures. Bernasconi, C. (Centre de Recherche de ELF a Solaize, Saint Symphorien D'Ozon (France)); Chaffardon, A.; Charleux, P.; Denis, J.; Gaillard, J.; Durand, J.P. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The storage stability of middle distillates is of great importance in France, because, on one hand, of their increasing demand, on the other hand, of the evolution of refining processes towards producing more and more unstable cracked products leading to gum and sediment formation. In this field, their work has consisted in evaluating middle distillates stabilize and additive effectiveness. Several mixtures of Straight Run Gas Oils and cat-cracked Light Cycle Oils have been subjected to different aging methods (2 hours at 120°C, 12 weeks at 43°C, 1 year at ambient temperature) followed by color and gravimetric determinations. The first method (120°C) has to be used as a screening test, while the second method (43°C) appears closely correlated with the actual storage. Unaged and aged middle distillates and sediments were analyzed by gas chromatography and mass spectrometry. Alkylindoles appear to be involved in L.C.O. degradation. L.C.O. fractionation has allowed to show the important degradation tendency of heavy 315+ fraction. Stabilizers such as aliphatic tertiary amines with a metal deactivator minimize the gum and sediment formation, but their action is more obvious if measured by accelerated aging methods; however, color darkening is harder to control.

44566 Solid absorbents as distillate fuel stability agents. Arfelli, W. (Dept. of Defense, Victoria (Australia)); Power, A.J.; Solly,

R.K. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Fuel Stability Foam (FSF) formulated from polyurethane was found to be very effective in greatly reducing the degradation of unstable diesel fuel on aging. When present in the fuel during the aging process at amounts of 0.2 g per liter of fuel, reduction in total particulate greater than 90%, improvements in fuel filterability approaching that of unaged fuel and reduction in fuel darkening were obtained. After insertion in fuel systems, FSF will displace less than 0.5% of the fuel volume and provide continued protection against fuel degradation over a long period for each batch of fuel with which it is in contact. The high level of protection against fuel degradation provided by FSF is effective in the presence of diesel fuel deposit promoters such as organic acids, aromatic thiols and fuel soluble copper. The major fuel stabilization mechanisms of FSF are proposed to be adsorption of fuel deposit precursors, soluble particulate species, insoluble particulate and degradation catalysts. Following from these adsorption processes, FSF is also effective in reversing the degradation of degraded fuel with which it is in contact.

44567 Storage stability changes with commercially available diesel fuel winterizing additives in the United States. Pipenger, G.G. (Amalgamated Coal and Petroleum Specialists, Inc., Fort Wayne, IN (USA)). pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Commercially available winter additives for diesel fuel claim to correct a variety of fuel-related problems, including long term storage instability. The flow and cetane improvement claims of these products have been tested and in some cases documented. Correction of stability problems with these commercially available additives may not be possible and testing must be accomplished to verify any claims. A total of twenty-nine (29) commercially-available additive treatments were tested on three untreated consumer-available fuels. Samples were blind-labelled to ensure objectivity and were sent to independent testing facilities for evaluations of the following properties: (1) Stability Improvement; (2) Biocidal Effectiveness; (3) Cetane Number; (4) Cloud Point; (5) Pour Point. The diesel fuel test samples purchased were obtained from three different suppliers in the midwestern US. The fuels selected were typical of the grade of No-2 diesel fuels supplied to the US transportation markets, all meeting the current American Society for Testing and Materials (ASTM) specification D975 for diesel fuels. The additive treatments were purchased in the continental US and were selected using the following criteria: (1) readily available in the US; (2) winterizing benefits advertised; (3) multifunctional capability promoted. Conclusions were made based on the statistical comparison of ASTM D2274 oxidation stability test results, incorporating effectiveness on each product in the three base fuels. Specific additive brand names are omitted from the study.

44568 Stability measurements of military and commercial marine fuels from a worldwide survey. Beal, E.J. (Naval Research Lab., Washington, DC (USA)); Hardy, D.R.; Hazlett, R.N.; Burnett, J.C.; Giannini, R.; Strucko, R. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

As a part of a continuing US Navy mobility fuels flexibility program, the storage stabilities of 22 military (NATO F-76) fuels and 26 commercial marine fuels from a worldwide survey taken in 1986 were evaluated. The commercial fuels were marine gas oils (MGO) which are very similar to current use F-76 fuels. Accelerated storage stability tests included 43°C bottle tests, ASTM D 2274 and a new low pressure reactor test at 90°C and 100 psig overpressure of oxygen. Results from all three stability tests on both categories of fuel will be presented along with conclusions based on fuel type and geographical location.

44569 Comparison of thermodynamics of nitrogen and sulfur compounds implicated in fuel stability problems. Sutterfield, F.D. (National Institute for Petroleum and Energy Research, Bartlesville, OK (USA)); Steele, W.V.; Archer, D.G.; Chirico, R.D.; Strube, M.M. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The thiophenes, pyrroles, and pyridines are the most resistant compounds to present day hydrogenation practices. Thermodynamic calculations indicate that the production of these compounds is favored under the commercial hydrogenation conditions employed. The removal of substituted compounds of this type is even more difficult, with the biggest kinetic hindrance coming when the substitution is alpha to heteroatom. These compounds are also considered to be some of the most active gum promoters from both reactivity and catalytic activity. They are also known to promote inordinate amounts of deposits during thermal stressing of the fuels. As feedstocks have more inherent problems, it becomes more imperative to remove compounds known to react or promote the formation of gums and residues during storage or thermal stressing.

44570 Study of fuel degradation processes by UV laser technique. Rotel, M. (Israel Institute of Metals, Haifa); Zahavi, J.; Por, N.; Ben-Asher, Y. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Irradiation of diesel fuel drops by an excimer laser working at 193 nm was used to stimulate degradation processes with a view to evaluating relative instabilities of the fuel and insight into the processes involved. Two aspects were studied: deposits produced on microscope slides, and the changes in composition following the irradiation. Deposits obtained from partially-cracked stock were darker and denser and had higher weights than those obtained from straight-run stock. Correlation between the deposits and laser conditions was investigated. Analysis of the irradiated fuel revealed an increase in gum and peroxide content.

44571 Investigation of sediment precursors present in cracked gas oil. Pedley, J.F. (Royal Aerospace Establishment, Fairmile Cobham Surrey (England)); Hiley, R.W. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

At the 2nd International Conference the authors reported the discovery of sediment precursor compounds. It was suggested that these compounds occur in solution in degrading fuel and are converted to insoluble sediment by the action of strong acids. In this paper the authors describe the isolation of two related groups of the compounds from a degrading catalytically-cracked gas oil using combined normal and reversed phase chromatography. The isolated groups were characterized using principally mass spectrometry and the precursor compounds were tentatively identified as consisting of indoles linked to polycyclic aromatic hydrocarbons. A subsequent search showed that the corresponding aromatic hydrocarbon species could be found in degrading cracked gas oil. They conclude that the precursor compounds could have been formed by the condensation of these oxidation products with indoles.

44572 Synthesis of sediment precursor compounds and simulation of sediment formation in cracked gas oil using model systems. Pedley, J.F. (Royal Aerospace Establishment, Fairmile Cobham Surrey (England)); Hiley, R.W. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Compounds which are closely related to the sediment precursor species extracted from degrading catalytically-cracked gas oil have been synthesized by the condensation of indoles with polycyclic

aromatic ketones. Spectral data including proton NMR for these compounds will be presented and possible structures discussed. Sediment formation has been simulated in model systems which contained various combinations of pure compounds representing suspected active species. The active components, which included an indole, thiol and polycyclic aromatic hydrocarbon, were dissolved into a stable straight-run gas oil at concentrations representative of those in finished fuels and the blends stored at 25°C for 6 months. The results of these tests including characterization of the sediments formed will be reported, and their significance in the context of sediment prevention will be discussed.

44573 Examination of fuel deposits from various sources by pyrolysis/field ionization mass spectrometry. Malhotra, R. (SRI International, Menlo Park, CA (USA)); St. John, G.A. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Pyrolysis/field ionization mass spectroscopy is a used for characterizing fuel deposits. In this paper, the authors identified two major spectral patterns that recur in deposits from various diesel fuels. Indoles and dihydroquinolines are strongly implicated in deposit formation. From their thermal evolution profile, the authors conclude that the substances are not merely entrapped in the sediment, but are chemically bonded. Both the adherent gum and filtered sediments appear to have the same chemical nature with minor differences. The study shows that the nature of the deposit is not changed drastically by increasing the temperature of aging from ambient to 120 degrees C. Further work is needed to understand the significance of the changes in order to validate the use of elevated temperatures for accelerated aging tests. Doping with DBSA, unlike that with DMP, results in deposits that resemble those from undoped fuels. Thus, the chemistry leading to the oxidation of sulfur compounds to sulfonic acids appears to be very relevant to the question of storage stability.

44574 Studies of fuel deterioration and additive-inhibition mechanisms. Westbrook, S.R. (Southwest Research Institute, San Antonio, TX (USA)); Stavinoha, L.L.; Present, D.L.; Hsu, J.P.; Herrera, J.G. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Insolubles in diesel fuels are known to occur through several mechanisms, some of which include polymerization, condensation, and acid base reactions. Recent studies have revealed that acid base reactions (or acid-catalyzed reactions) are especially important in the formation of sediments in fuels containing catalytically cracked stock. Evidence also exists that simply removing the acid and base fractions of the fuel does not completely eliminate sediment formation, which would indicate some sort of preliminary reaction, such as oxidation. Fuels containing little or no cracked stock are usually subject to different reactions to form insolubles. The type of additive that used to reduce insolubles formation depends on the reactions that occur to produce the insolubles. For these reasons, additive efficacy will vary between fuels. During this study, the formations of fuel insolubles in a straight run fuel, a light cycle oil, and a blend of the two were studied. The test fuels were stored at 80°C for periods up to 28 days. The effects of several commercial fuel stabilizer additives and one pure compound on sediment formation were also studied. The fuels and fuel sediments were analyzed, and the results were used to develop a model system. Studies of the formation of insolubles during the aging of the model system showed the importance of acids in sediment formation. The inhibition mechanism of one fuel stabilizer, N,N'-dimethylcyclohexylamine, was also studied. The usefulness of the model system for evaluating stabilizer additive effectiveness was also demonstrated.

44575 Development of reference fuels for use with the ASTM D2274 test for fuel storage stability. Klinkhammer, M.D. (David Taylor Research Center, Bethesda, MD (USA)); White, E.W.; Flohr, K.W. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The reproducibility of the ASTM D2274 method for evaluating the stability of middle distillate fuels is poor. Differences between results obtained by two laboratories or by two operators in one laboratory may be large. A significant portion of the differences rests with operator idiosyncrasies and failure to follow the procedure. Reference fuels are needed to qualify apparatus and to train and check operators. DTRC and ARTECH CORP. are engaged in the development of such reference fuels. Because a petroleum-based fuel set aside as a reference would be subject to aging and to the effects of shipping conditions, the authors have based their reference fuels on a small number of pure compounds that can be blended in a series of standard ratios immediately prior to use. Initially, n-dodecane, t-amylbenzene, and 1-dodecene have been chosen to present the paraffinic, aromatic, and olefinic components of diesel fuels. These are blended in a 75/22.5/2.5 volume ratio to form a base fuel. A known sediment-former (1,2,5-trimethylpyrrole) is added in various concentrations to produce a series of reference fuels. The resultant reference fuels have been subjected to stressing in the D2274 apparatus for periods between 4 and 96 hours, in addition to the standard 16-hour period, by four analysts to develop a sense of repeatability. Precision and agreement for experienced D2274 operators was good. Curves showing total insolubles as a function of D2274 test time or as a function of initial 1,2,5-trimethylpyrrole will permit the fuel stability community to use these reference fuels for training personnel and for checking personnel and equipment. The shelf life of the 1,2,5-trimethylpyrrole, the use of other sediment-forming compounds, synergistic effects, and an ASTM round-robin study are possible areas for further work.

44576 Study of precursors in the formation of insoluble products during the aging of middle distillate fuels. Klinkhammer, M.D. (David Taylor Research Center, Bethesda, MD (USA)); White, E.W.; Flohr, K.W. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The identification of precursors to insolubles formation in middle distillate fuels during storage may be the key to an improved method for identifying unstable fuels. Consequently, DTRC and its contractor, ARTECH CORP., conducted a gas chromatographic (GC) study of both unstressed fuel and fuel and insolubles following various bottle storage regimes, viz. 43°C for eight weeks, 65°C for one, three, and eight weeks and 95°C for one week. Three types of detectors were used with the GC unit, a flame ionization detector, an electron capture detector, and a thermionic-specific (nitrogen-phosphorus specific) detector. Prior to stressing, all three fuels used in the program contained detectable amounts of material similar to the major components later found in the filterable and adherent insolubles. These precursors increased in concentration in the filtered fuels following stressing as the stressing conditions became more severe. It was found that the adherent insolubles and the filterable insolubles were almost identical by gas chromatographic techniques. It is thought that further development may well result in a test which will supplement the currently-used ASTM D2274 procedure or other accelerated stability test.

44577 Measurement of low levels of strong acids in gas oils. Marshman, S.J. (Royal Aerospace Establishment, Fairmile Cobham Surrey (England)). pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Chemical species which have been reported to affect the storage stability of diesel fuels include organic acids, and phenalene and its homologues. In storage stability studies reported elsewhere, the addition of organic acids has been shown to enhance the production of insoluble degradation products from gas oil. The strength of the acids added is also considered to be a factor affecting sediment formation. Methods currently used to determine acidity, such as ASTM

D664, are not sufficiently sensitive to determine the levels of strong acids in gas oils. New conductometric and potentiometric titration methods have therefore been developed to measure the type and quantity of organic acids present. These techniques are sufficiently sensitive to detect low ppm levels of strong acids. The results from each of these methods were compared for a number of gas oils. Acidity measurements for a straight-run and a catalytically-cracked gas oil were obtained during ambient storage studies. Phenalene and its homologues have been detected in a catalytically cracked diesel fuel and quantified by means of a two-stage chromatographic procedure utilizing oxidative electrochemical detection.

44578 Development of predictive tests for fuel stability. Li, N.C. (Duquesne Univ., Pittsburgh, PA (USA)); Chang, H.; Wang, S.M.; Huang, P.J.; Tzou, J.R. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Heteroatoms (O,N,S) and unsaturated compounds exert deleterious effects on the stability of a liquid fuel by promotion of deposit formation on storage. Since deposit techniques for determination of fuel stability require long times of storage, predictive tests should be developed in order to save observation time. Light scattering measurements, before onset of sedimentation, is a predictive test. Inductively coupled plasma atomic emission (ICP-AES) and atomic absorption (AA) are very sensitive methods for measuring trace amounts of metal and constitute other predictive tests for fuel stability. A metal powder, Cu, Al or Fe, is added to the fuel. Various amounts of unsaturated and S,O,N-containing compounds are added to the fuel to accelerate aging. After standing for various short intervals, again before the onset of sedimentation, the metal powder is removed and the metal content in the fuel is determined by ICP-AES or AA. The predictive tests show that the deleterious effects of metals are in the order Cu > Al, Fe. The extents of light scattering and of metal drawn into the fuel from added metal powder are correlated with the extent of deposit formed in degradation of the fuel, and a mechanism is suggested for sediment formation with sulfur compounds. The authors have applied Raman spectroscopy, nuclear magnetic resonance, electron spin resonance, and electron spectrum for chemical analysis (ESCA) techniques to the characterization of deposits.

44579 Study of stability of diesel fuels under operational conditions. Zahavi, E. (Israel Fuel Corp. Ltd., Tel Aviv); Shavit, A.B.; Ben-Asher, J.; Por, N. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Although no significant degradation of diesel fuel quality has been observed in conventional storage of locally produced straight run stock, formation of degradation products in bus engine fuel systems has been observed by filter clogging and deposit formation. The main cause for these field operational problems may be attributed to the fact that diesel fuel, which serves also as an injector coolant, most probably deteriorates at the relatively high temperatures prevailing in part of the fuel system. Two different straight run diesel fuels, a blend of light cycle oil and straight run diesel fuel with and without a stabilizer additive (qualified by US Department of Defense according to MIL-S-53021), have been studied in buses of the public transportation system during actual road service. The initial fuel properties of the gas oils have been tested, and finally the 10% of the remaining unconsumed gas oils, which were taken from the systems, were evaluated in view of stability by four different stability tests. It was found that diesel fuel types, tested during this study, deteriorated upon actual road service. The loss in stability resulted in formation of insoluble sediments, increase in acidity and low filtration rates. Addition of fuel stabilizer, qualified under MIL-S-53021, induced a better filterability on the two straight run stocks, accompanied by a reduced rate of filtration of the unstable blend.

44580 Stability of motor diesel fuels and prognostication of their storage terms. Kalitchin, Z. (Institute of Organic Chemistry, Sofia (Bulgaria)); Ivanov, S.; Tanielian, S.; Ivanov, A.; Georgieve, P.; Kanariev, K.; Boneva, M. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The possibility for long term storage of the properties of diesel fuels is determined by their physical and chemical stability. For evaluation of the chemical stability, acid number, insoluble gum, total insolubles, absorption of oxygen, and optical density are among the more important characteristics. It is generally considered that diesel fuels containing components of direct distillation can be stored for 3 to 5 years. The most important parameters for all types of diesel fuels are considered to be the insoluble gum and total insolubles. The purpose of this paper is to study the chemical stability of model diesel fuels and of different components at elevated temperatures in order to see their behavior during storage under real conditions.

44581 Assessing distillate fuel storage stability by oxygen overpressure. Hardy, D.R. (Naval Research Lab., Washington, DC (USA)); Beal, E.J.; Hazlett, R.N.; Burnett, J.C. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

This paper describes a new method for determining a distillate fuel's tendency for forming deleterious fuel insoluble products during ambient storage. Oxygen is forced into solution in the fuel at pressures up to 700 kPa (100 psi) at temperatures up to 80°C for up to 96 hours in order to accelerate the reactions which take place at ambient pressure and temperature in the field or laboratory. The method then makes use of gravimetric determination of the total insolubles formed. The method is predictive for up to three years of ambient conditions, and it is rapid and very precise. It has been used to rank additive free fuels over a wide range of storage stabilities and has also been useful in assessing the relative effectiveness of middle distillate fuel stabilizer (antioxidant) additives. Details of the new method will be given along with data comparing traditional bottle type tests at various temperatures with results from the new technique. At any given temperature for any given fuel, the data indicate a significant acceleration of insoluble sediment formation. Thus, the test has considerable usefulness, both in quality assurance and as a research tool to investigate autoxidation chemistry.

44582 Study of variables affecting results obtained in the ASTM D2274 accelerated stability test. White, E.W. (David Taylor Research Center, Bethesda, MD (USA)); Bowen, R.J. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

This paper examines selected chemical and physical variables that could possibly affect results obtained in the ASTM D2274 accelerated stability test. It is a continuation of the work reported as the 2nd International Conference in San Antonio, Texas. Together, the two papers summarize the results of a David Taylor Research Center study of critical factors in the D2274 procedure. The chemical factors addressed are the concentration of oxygen in the gas that is introduced into the fuel and catalysis of the instability reaction. The aspects of the oxidation cell that are addressed include the method of introducing oxygen; the wetted surface-to-fuel ratio; and the cell age (number of prior uses). Oxidation bath factors include the location of the cell in the bath; the speed of temperature recovery following introduction of the cells; and a comparison of an 8-cell with a 12-cell bath. The single post-stress factor addressed is the drying time of the filterable solids. The authors recommend that users of the D2274 procedure use only high purity oxygen; refrain from the use of unlined metallic shipping containers; and protect samples from UV radiation and excessive agitation. The effects of the wetted surface-to-fuel volume ratio and of cell age are not critical in the D2274 procedure. Different baths give different results, probably the result of different temperature recovery rates following

cell introduction. The current one-hour drying time specified for the filterable insolubles is not adequate and probably should be increased to at least 2.5 hours.

44583 Operability of automotive diesel engines with unstable fuels accelerated stability tests relevance. Martin, B. (Institut Francais du Petrole, Rueil-Malmaison (France)); Montagne, X.; Bernasconi, C. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Operability problems (filter plugging or injector fouling) may encounter when unstable fuel is used. The aim of this work is to study relevance of accelerated tests for prediction of these operability problems. So 50 liters of fuel have been aged in steel tanks at different temperatures. Evolution of quality during storage is monitored by filterable sediments weights, filter blocking tendency and injector fouling tendency. At the same time, observation of sediments by SEM permits them to see the influence of temperature on size and shape of particles. The results confirm that degradation of fuel is different according to the temperature. It is important to notice that a fuel may present a high filter blocking tendency despite a low weight of sediments produced during storage. Aging affects the thermal stability of fuels and their injector fouling tendency.

44584 Fuel filtration characteristics of vehicle filter media. McVea, G.G. (Dept. of Defense, Victoria (Australia)); Medwell, M.E.; Power, A.J.; Solly, R.K. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Clusters of 1-2 micron spherical particles of organic matter formed by storage degradation of diesel fuel were found to pass through vehicle filter media of 10 micron nominal pore size but to be retained by filters of 2 micron nominal pore size. In contrast, a suspension of a silica dust of similar particle size to the organic particulate matter, was largely retained by the vehicle filters. As a result of the dust particles being retained in the voids of the filter media, the vehicle filters were more rapidly blocked by the silica dust than the organic particulate. The probability of the clusters of organic particulate matter passing through a filter paper are reduced by the presence of other insolubles such as microbiological and inorganic material. Once retained, the clusters of small spheres may be molded to fill voids in the filter media. In these circumstances, the presence of organic particulate matter in fuel will lead to very rapid filter blockage.

44585 Particulate contamination of jet fuel systems. Dekel, R. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

In modern aircraft, the fuel filtration system includes a gross airframe screen of 2500 micros at the boost pump inlet, a 500 micro basket type filter at the main fuel flow passages of the engine fuel control, and finally a 35-50 micro filter between the boost pump and the main engine high pressure pump to protect the fuel flow to the core engine and the fuel control. The purpose of this study is to: (1) To identify the sort of contaminants in jet fuel systems and their sources; (2) To find a correlation between sort, kind, and size of particulates and parameters such as filter blockage during flight or engine malfunction; (3) To find out how fuel supply and structure work on the aircraft tanks and how other parameters influence the overall particulate contamination in the jet system; and (4) To develop a quick and reliable test for measuring "the critical particulate contamination" which during flight can be the cause of filter blockage in the jet fuel system.

44586 Biogeochemistry of sludge that forms in salt dome caverns used for strategic storage of crude oil. Giles, H.N. (Dept. of Energy, Washington, DC (USA)); Woodward, P.W.; Neihof, R.A. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

In many salt dome solution-mined caverns used for the strategic storage of crude oil, a sludge or emulsion layer accumulates over time at the oil/brine interface. This layer typically comprises less than 0.5% of the volume of crude oil stored. Relative to the overlying crude oil, the sludge is enriched in trace metals and acidic components; has a high sediment, water, salt, and ash content; exhibits a bimodal distribution of the paraffins, with maxima at about nC_{17} and nC_{45}; and is depleted in basic components, nitrogen, and sulfur. The apparent depletion in nitrogen and sulfur is probably a result of dilution by water, waxes, and the heterogeneous components comprising the sludge rather than an actual loss. Some of the water is present as a very stable emulsion, contrary to the normal tendency of emulsions to be relatively unstable in highly saline systems. Viable aerobic and anaerobic bacteria have been found in some storage caverns despite the hypersalinity of the environment, but all physical and chemical evidence to date demonstrates that these bacteria are not degrading the stored crude oil. Under storage conditions, the bacteria are apparently dormant. Carbon and deuterium stable isotope ratio analyses of methane present in the sludge layer indicate that it is of petrogenic origin and not formed by bacterial alteration of the crude oil. The sludge does not appear to be a result of incompatibility between the various crude oil streams typically commingled during cavern fill. In fact, sludge also forms in caverns with only a single crude oil stream in storage. The formation of sludge is likely a natural phenomenon resulting from settling out of suspended and agglomerated colloidal constituents of the crude oil.

44587 Water-sensitivity of diesel fuels: effects of composition and aging. Bocard, C. (Institut Francais du Petrole, Rueil-Malmaison (France)); Castaing, G.; Bernasconi, C. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

It has long been recognized that filter plugging in diesel engines is often caused by the growth of micro-organisms when water has entered storage or ship tanks but little is known about the physicochemical effects of water and specially the interactions between water and gums which form by aging of fuels. The water-sensitivity of six fuels (straight-run distillates and mixtures containing low-sulfur and high-sulfur Light Cycle Oil distillates) is studied by contacting fuel with water according to different methods: emulsification by mechanical mixing at different energy levels, condensation caused by temperature changes, static contact with a water phase while aging at 43°C. The effect of water on the filtrability of fuels is characterized by a Filter Blocking Tendency (FBT) value determined in a pressure-volume test using two membranes: a Whatman GFA filter (1.6 micrometers glass fiber) and a diesel Purflux filter (5-10 micrometers paper). It is shown that GFA filters are very sensitive to both water and gums independently or associated and that their plugging by water could be enhanced by a high paraffin content. Plugging of paper filters, caused mainly by gums, can be enhanced or mitigated by water, depending on the conditions of mixing and on the nature of fuel. Water has only little effect on the effectiveness of an antioxidant additive.

44588 User guidelines for diesel fuel handling and storage. Westbrook, S.R. (Southwest Research Institute, San Antonio, TX (USA)); Stavinoha, L.L. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Contaminated or degraded fuel can plug filters, foul injectors, or cause other types of operational problems. For this reason, it is critical that diesel fuel handling and storage procedures provide maximum protection against contamination and deterioration of the fuel. This paper is a summary of guidelines for handling and storage of diesel fuel. Topics discussed include contaminants, specifications, acceptance criteria, fuel and fuel system monitoring, additives, and corrective actions.

44589 Additive response and the effect of the chemical composition on storage stability of diesel fuels. Ben-Asher, J. (Israel Institute of Petroleum and Energy, Tel Aviv); Por, N.; Shavit, A.B. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The American Society for Testing and Materials has accepted the Oxidation Stability of Distillate Fuel Oil Test (ASTM D-2274) as the standard test for assessment of inherent stability of diesel fuels. Nevertheless its reproducibility and predictive potential are still in doubt. There is a need for an improved test technique to monitor diesel fuel stability during production, distribution and storage. Two alternative stability test techniques were chosen for evaluation. The results were compared to results obtained by the ASTM D-2274 test. Oven Storage Test method at 50°c provided inherent fuel stability base-line comparison data for assessment of the results obtained by the other accelerated stability test methods. Five diesel fuels were subjected to the different testing procedures: three fuels were straight run products typical of local production, two fuels were unstable blends containing LCO. The potential stability of the fuels has been evaluated as such and in the presence of five different multifunctional additives. For the first time, to the best of their knowledge, the Rapid Oven Test at 200°F for evaluating the storage stability of gasolines has been used to evaluate the storage stability of diesel fuels. The results obtained by this accelerated technique served for clarification of the breakdown mechanism of diesel fuels under study. A new stability criteria has been proposed and employed for ranking the fuels according to their stability.

44590 Analytical techniques for monitoring antioxidant depletion in jet fuels. Pearson, C.D. (IIT Research Institute, Bartlesville, OK (USA)); Vogh, J.W. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). DOE Contract FC22-83FE60149. From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Antioxidants are used at low ppm levels to protect jet fuels against peroxide and sediment formation. The low levels used (ca. 20 ppm) make quantitation difficult. In order to follow reactions leading to additive depletion and subsequent fuel degradation, the authors have developed two analytical techniques that can accurately and reproducibly determine the level of hindered phenol antioxidants in jet fuels. Specific antioxidants addressed are 2,6,-di-tert-butyl-4-methyl phenol (BHT) and 2,4-tert-butylphenol supplied by DuPont as commercial antioxidants. The two approaches involve the use of a gas chromatography/quadrupole mass spectrometer and an HPLC with an electrochemical detector. The techniques have been tested on a range of jet fuels and appear free from interference.

44591 Thermal instability mechanism of jet fuels. Brinkman, D.W. (IIT Research Institute, Bartlesville, OK (USA)); Bhan, O.K.; Green, J.B.; Goetzinger, J.W.; Grigsby, R.D.; Kamin, R. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Six jet fuels were thermally stressed in a JFTOT apparatus, resulting in the formation of tube deposits and filterable sediments. Liquid chromatographic separation was used to produce fractions and subfractions from the fuels before and after thermal stressing. An acidic subfraction from one of the fuels was analyzed by GC/MS, and significant differences in the concentrations of hydroxyaromatics were found. High resolution mass spectrometry was used to analyze the tube deposits and filterable sediments. In addition, several of the sediments were analyzed by GC/MS. Numerous compound types were identified. Especially prominent were aromatic hydrocarbons and aromatic compounds containing oxygen, nitrogen, and sulfur. A number of significant differences were found in comparing the analytical results from the deposits and sediments from the same fuel and in comparing results between fuels.

44592 Small-scale reactor for fuel oxidation testing. Stirling, K.Q. (IIT Research Institute, Bartlesville, OK (USA)); Brinkman, D.W.; Sutterfield, F.D. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

The oxygen overpressure test is one result of a multilaboratory study to evaluate the use of antioxidant additives in Naval Distillate Fuel. Four test techniques were used to measure the amount of filterable sediment and adherent gum in each of the fuel/additive blends. Specifications testing was done on the neat fuels (those without additives). Some blends were also tested to ensure that the antioxidants did not cause off-specification fuel. It was found that the ASTM D 2274 was adequate for evaluating the long-term storage stability of straight-run middle distillates, it may not be as effective for fuel blends containing catalytically cracked materials. In the antioxidant additive study the ASTM D 2274 incorrectly predicted the behavior of four out of six fuels. A new storage stability technique is needed for procurement of fuel blends containing light cycle oils.

44593 Characterization of particulate matter in aged diesel fuel. Baran, I.J. (Dept. of Defense, Victoria (Australia)); Power, A.J.; Solly, R.K. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Organic particulate matter formed in both naturally and thermally accelerated aged diesel fuel has been characterized with the aid of an electron microscope. All particles formed as a result of chemical degradation of the fuel were spheres of 1-2 microns diameter, with most being approximately 1 micron in diameter. The spherical particles clustered together to form chains, with chain lengths up to 25 microns being observed in this study. Particle counts were determined on a HIAC Particle Counter during the mild thermal accelerated aging of fuel at 43C in the presence and absence of polyurethane Fuel Stability Foam (FSF). In the reference fuel, the number of particles registering as less than 10 microns in size reached a maximum after 5 weeks, then decreased. Species registering greater than 10 microns increased in number throughout the 8 week experimental time as would be expected from the clustering of the smaller spherical particles. In the presence of FSF, the number of particles less than 10 microns remain virtually unchanged from the initial unaged fuel, while the number of clusters greater than 10 microns showed a gradual increase. Mycelia from the common fuel fungus, HORMOCONIS resinae (CLADOSPORIUM resinae), were branched and linear structures to lengths exceeding 0.5 mm, whereas the spores were ovals, approximately 2 by 4 microns in size.

44594 Field trials illustrating the long term effectiveness of methyl-isothiazolones in the preservation of liquid fuels. Dorris, M.M. (Rohn and Haas Co., Philadelphia, PA (USA)); Pitcher, D.G.; Carmody, D.P. pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

Methyl-Isothiazolone biocides have been used in both Europe and the US for the last five years. During this period, many field trials have been performed to demonstrate the Methyl-Isothiazolone's performance. This poster describes the biocide's performance features and illustrates two field trials (one with a utility and one for the French Navy). In these field trials, one single dose of biocide (2.8 ppm active ingredient based on the total tank volume) protected stored fuel from microbiological contamination for at least two years. This illustrates the long term effectiveness of Methyl-Isothiazolone biocides.

44595 Inground concrete tanks for storage of petroleum products. Duncan, K.J. (Thomson and Van Eck International, London (England)). pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of

Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

This paper deals with the storage of petroleum products in concrete tank. A brief historical background on the use of concrete tanks is given, along with a section on economics, security, vapor loss control, operation and maintenance.

44596 Fuel related problems at a nuclear power plant of the emergency diesel generator system. Chesneau, H.L. (Fuel Quality Services, Inc., Buford, GA (USA)). pp. 456 of Third international conference on stability and handling of liquid fuels. Conference proceedings: Volume 2. Hiley, R.W.; Penfold, R.E.; Pedley, J.F. (eds.) The Institute of Petroleum, London, United Kingdom (1988). From 3. international conference on stability and handling of liquid fuels; 13-16 Sep 1988.

This paper deals with a problem that developed in an emergency generator system at a nuclear power plant in the southeast United States. The report indicated that a fuel sample from the Diesel Fuel Oil Storage Tank (DFOST) contained water and sediment equal to 0.15% when the technical specification limit was 0.05%. A review of the DFOST sampling procedure revealed that sampling instructions contained little detail about how samples were to be collected and that the sampling resulted in a false reading. It was recommended that the diesel be drained and the tank cleaned, but this posed a problem since the Nuclear Regulatory Commission requires 40,000 gallons of fuel to be available for this system. A procedure for cleaning the DFOST was initiated. The fuel oil was drained from the tank and filtered through a one micron filter into tankers that were brought onto the plant site. The diesel fuel was then pumped from the tankers through a filter system consisting of clay and followed by a 0.5 micron filter. Blotter testing indicated the fuel was being restored to a much higher cleanliness rating. In addition, a fuel stabilizer was added.

0250 Combustion

Refer also to citation(s) 44873

03 NATURAL GAS

Refer also to citation(s) 44462, 44464

0302 Geology and Exploration

44597 (NEI-NO–90, pp. 18) **Shallow gas problems. Example Haltenbanken.** Tiballs, K.B. Norske Sivilingenioerers Forening, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with the shallow gas problems at Haltenbanken on the Norwegian continental shelf. The lithology and stratigraphy of rocks in the area are compared with the results from the Measurement While Drilling (MWD) method. Examples are given. 13 figures.

44598 (SAND–88-3298) **Fracturing along the Grand Hogback, Garfield County, Colorado.** Garrett, C.H.; Lorenz, J.C. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 35p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC04-76DP00789. Order Number DE89015198/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The several sets of fractures found in steeply dipping Mesaverde strata along the Grand Hogback, northwest Colorado, have previously been interpreted to be either (1) entirely of pre-uplift origin, or (2) entirely caused by stresses created during folding and uplift. However, based on fracture characteristics measured at 32 locations along the Grand Hogback, we suggest that only the major fracture set formed prior to uplift, and corresponds to subsurface fractures in nearby flat-lying reservoirs. These are the oldest fractures, which developed in the Mesaverde Group and lower Wasatch Formation as a set of west-northwest trending, through-going, regional fractures in response to horizontal compression. Secondary sets of northwest through northeast trending, cross-cutting fractures post-date the west-northwest fracture set and can be related to stresses caused by structural deformation and exposure of the strata along the Grand Hogback. These cross-cutting fractures are suggested to have resulted from several different mechanisms: (1) as relaxation fractures that formed subsequent to the early fracture event, (2) as fractures that formed on the north-south trending section of the Grand Hogback in response to cross-sectional folding, and (3) as fractures that formed on the sinuous and east-west trending sections of the Grand Hogback in response to planar folding. The cross-cutting fractures are developed widely along the Grand Hogback but are rare in the subsurface. Conjugate shear fractures in the lower Wasatch Formation formed in response to east-west compression and post-date folding. 17 refs., 12 figs.

44599 (SV-UG–1989-20) **Geophysical and geochemical investigations in connection with tectonic lineaments in the Stockholm archipelago - investigations at Vettershaga and Stavsnaes, 1984-1988.** Soederberg, P.; Floden, T. Swedish State Power Board, Vaellingby (Sweden). 11 Jan 1989. 85p. (In Swedish). Order Number DE89914801/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

A number of different natural phenomena in the Stockholm Archipelago have focused our attention to outflows of natural gas along tectonic lineaments. The observed phenomena include gas discharges at the surface along fairways and in bays as well as depression structures (pockmarks) in the bottom sediment. In order to find the sources, migration paths and possible accumulation structures for the gas, we have performed geophysical and geochemical investigations along some of the major tectonic lineaments of the Archipelago. The investigations show that apart from the biogenic gas which is produced within the upper parts of the postglacial gyttja layers, an outflow of thermogenic gas occurs locally along the tectonic lineaments. The thermogenic gas is assumed to have migrated from sources at deep levels in the earths crust. The seabed sediments have been analyzed regarding hydrocarbons and carbon isotopes across two of the dominating lineaments of the archipelago. Samplings of free gas at the bedrock level has furthermore been performed. The analyses show that the bulk of the gas here is of a biologic origin according to established classification, but it has a distinct contribution of thermogenic gas as well.

0303 Drilling, Production, and Processing

Refer also to citation(s) 44485, 44486, 44492, 44498

44600 (NEI-DK–192, pp. 7/1-7/17) **Two-phase flow project.** Gottlieb, L. (LICconsult (DK)). Industri- og Handelsstyrelsen, Copenhagen (Denmark). Formidlingsraadet. Jan 1989. (CONF-8709461–: Hearing on presentation of low cost contribution to hydrocarbon projects, 22-23 Sep 1987). In *Presentation of low cost contribution to hydrocarbon projects.* Order Number DE89914663/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Graphs illustrating the two-phase flow simulator, basic equations, simulated pipe velocity profiles, simulated pressure drop (4 North Sea two-phase lines), the Frigg.St.Fergus Gas Condensation Line (case stury) slugging (basic methodology, laboratory results, simulated time derivative of gas flow at riser bed, and simulations versus field observations). (AB).

0305 Health and Safety

Refer also to citation(s) 44503, 45888, 46319

0306 Marketing and Economics

Refer also to citation(s) 45236

44601 (CMI-R–30705-1) **Socio-economic correct pricing of Norwegian natural gas for domestic electric power production.** Aarrestad, J. Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway). Nov 1988. 26p. (In Norwegian). Order Number DE89914737/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report is analyzed how the electric power production by means of natural gas can influence the adjustment in the electric

power market. In more detail is examined how the optimal price of Norwegian natural gas delivered at the power station site can be calculated. The notion "resource rent" is important in this context. 8 refs., 6 figs.

44602 (CMI-R–30705-2) **Value of the Norwegian natural gas.** Moxnes, E.; Nansve, A.H.; Aarrestad, J. Christian Michelsens Inst. for Vitenskap og Aandsfrihet, Bergen (Norway). Dec 1988. 28p. (In Norwegian). Order Number DE89914736/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In this report calculations are made of the interest rate of the resources of Norwegian natural gas under various assumptions. Future gas production is either given, or it is determined by maximising the profit. The calculations indicate that the resource rent is substantial already in 1995, and that it will increase for some time to come in the next century. 13 refs., 10 figs.

44603 (DOE/EIA–0130(89/06)) **Natural gas monthly, June 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. 28 Aug 1989. 149p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016740/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Natural Gas Monthly (NGM) is prepared in the Data Operations Branch of the Reserves and Natural Gas Division, Office of Oil and Gas, Energy Information Administration (EIA), US Department of Energy (DOE). The NGM highlights activities, events, and analyses of interest to public and private sector organizations associated with the natural gas industry. Volume and price data are presented each month for natural gas production, distribution, consumption, and interstate pipeline activities. Producer-related activities and underground storage data are also reported. From time to time, the NGM features articles designed to assist readers in using and interpreting natural gas information. The data in this publication are collected on surveys conducted by the EIA to fulfill its responsibilities for gathering and reporting energy data. Some of the data are collected under the authority of the Federal Energy Regulatory Commission (FERC), an independent commission within the DOE, which has jurisdiction primarily in the regulation of electric utilities and the interstate natural gas industry.

44604 (PB–89-204051/XAB) **Role of basic research in the gas industry: Technical video brief.** Gas Research Inst., Chicago, IL (USA). Jun 1984. 14p. (GRI–84/0245). Available from NTIS, PC A03/MF A01.

This report contains the text of a video interview with Dr. William R. Staats, the Director of Basic Research for the Gas Research Institute (GRI). The video interview provides an executive summary overview of basic research in the gas industry. The video tape is 17 minutes in length and may be obtained by contacting GRI's Technical Communications Department at (312)299-8124.

44605 (PB–89-204564/XAB) **Industrial natural gas markets: facts, fallacies, and forecasts. Topical report.** Samsa, M.E. Gas Research Inst., Washington, DC (USA). Strategic Analysis and Energy Forecasting Div. Mar 1989. 158p. (GRI–88/0316). Available from NTIS, PC A08/MF A01.

The industrial sector is the most complex of all energy markets. Even though industrial energy consumers are typically large and geographically concentrated, they are extremely heterogenous in their uses of energy. The fuel-use characteristics of any one facility, or any class of similar facilities, is dependent upon a host of product- and process-specific factors as well as individual plant design features. The analysis discusses how energy is used in the industrial sector, with particular attention paid to the competitive position of natural gas in principal industrial functional uses. The analysis clarifies, in a quantitative manner, many of the facts about industrial gas markets while dispelling many of the fallacies that have been promulgated based on anecdotal evidence.

44606 (PB–89-204580/XAB) **Putting R and D (research and development) results to work: the role of technology transfer. Annual report.** Farrell, M.D. Gas Research Inst., Chicago, IL (USA). Mar 1989. 48p. (GRI–88/0363). Available from NTIS, PC A03/MF A01.

This seminar focused on the ways in which the products of successful R&D make it to the marketplace, including discussion of how Gas Research Institute (GRI) accomplishes this transfer of technology in an environment of increasing competition among energy forms and services. The formal presentations outlined GRI's approach and experience, the challenges of technology transfer arising from market factors and policy constraints, and the experience of other organizations. Seminar participants agreed on the continued need for a robust technology transfer process at GRI that includes early commitment and participation from a commercializing partner. Gas-industry involvement in the form of project participation or strategic alliances to further the development and market introduction of a new product is also needed. Participants suggested that GRI look at ways to provide more flexibility in project planning and execution to allow for scientific invention and innovation along the development path as well as to tailor the end product to ensure commercializing partners, product advocates, and marketplace acceptance.

0309 Artificial Stimulation

44607 (PB–89-205116/XAB) **Development of microseismic methods to determine hydraulic-fracture dimensions. Annual report, December 1987-November 1988. Interim report.** Fix, J.E.; Adair, R.G.; Fisher, T.W.; Mahrer, K.D.; Mulcahy, C.C. Teledyne Geotech, Garland, TX (USA). May 1989. 258p. (TR–88-11). Available from NTIS, PC A12/MF A01.

Research was conducted on the determination of hydraulically stimulated fracture diagnostics using microseismic monitoring in the treatment well and in remote wells. A technique was developed to estimate the depth of the top and bottom of a fracture. The method has been demonstrated with four surveys. The successful height determination after four month's production demonstrates the application to previously fractured wells. Results from HYDCRAK models confirm the height technique. Tube waves were identified as a more prevalent and significant noise source than previously envisioned. Methods of identifying and dealing with tube-wave noise in acquisition and analysis were developed. Two algorithms were used to remove known tube waves: a prediction error filter to remove downgoing energy and a noise-conditioned filter. Both methods have significantly improved the S/N to allow detection of smaller microseismic signals. A re-evaluation of expected signal-to-noise ratios has been made for remote well surveys. Multiple signals detected during three remote well surveys are interpreted as being from the reservoir in the immediate vicinity of the monitor wells.

0310 Legislation and Regulation

Refer also to citation(s) 44524, 45225

44608 (ERCB–D88-20) **Dome Petroleum Ltd. well licence application Waterton field. Decision 88-20.** Energy Resources Conservation Board, Calgary, AB (Canada). [1989]. 21p. (CE–01747). Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Dome Petroleum applied for a license to drill a well to be located on the eastern slopes of the Rocky Mountains about 21 km west of Pincher Creek, Alberta. The geological zones of interest are designated as the Rundle C Pool which is typically gas-bearing. The proposed well was considered to have high enough H_2S concentrations and potential release rates to be of concern to the safety of local residents. A hearing was held to consider issues related to this application: the need for the well, the bottom-hole location of the well, the impacts of the proposed and alternative surface locations, and the adequacy of the drilling plan and the emergency response plan with respect to public safety. After considering the evidence presented at the hearing with respect to the need for the well and the impacts it presents to area residents, wildlife, the local environment, and safety and esthetic considerations, it was decided that many of the impacts can be mitigated by the choice of an appropriate surface location. An alternative surface location, about 100 m

north of the proposed well location, was approved, subject to certain requirements regarding containment of drilling and lease fluids, water quality testing, and emergency response plans. 2 figs.

44609 (ERCB–DD89-4) **Applications by Phillips Petroleum Resources, Ltd. for permits to construct pipelines to transport sour gas and fuel gas in the Salter Field. Addendum to Decision 88-4.** Hess, M. Energy Resources Conservation Board, Calgary, AB (Canada). [1989]. 13p. (CE–02756). Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A hearing was held in Alberta to consider matters relating to the routing of a gas pipeline. Part of the route had already been approved, but further evidence was heard on the western portion of the route. A number of local landowners presented views about the proposed routes and indicated how it would impact their properties. One landowner contended that the previous approval may have been based on misleading testimony and that an alternate route should be followed. Phillips Petroleum also submitted a preferred route for the western portion which was felt to be environmentally and economically superior to the alternative routes. After consideration of the evidence submitted, it was decided that the original alignment approved in the earlier application was the most appropriate and in the public interest, and that the contending landowner's application for variance of that alignment was denied. For the western portion of the route, the amended preferred route submitted by Phillips Petroleum was approved, subject to environmental approvals. 2 figs., 1 tab.

0320 Transport, Pipelines, and Handling

Refer also to citation(s) 44526, 44527, 44609, 45301, 45453

44610 (AGA–9015610) **Pipeline connection method and effects on deep water construction operations: Final report.** American Gas Association, Inc., New York, NY (USA); Brown (R.J.) and Associates of America, Inc., Houston, TX (USA). c Aug 1988. 253p. Sponsored by Battelle Columbus Laboratories. (PR–189-715). Available from American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $100.00.

This project proposes criteria for the selection or further development of reliable joining systems for pipeline installation by the vertical J-curve pipelay method. In order to contribute to the advancement of vertical pipelay installation, the report provides: an overview and catalog of existing and developmental mechanical pipe joining systems; a list of potential installation vessels along with current status and projected future development of each candidate; and a program of tests to establish acceptable joining systems (and especially to eliminate unacceptable joining systems) by subjecting candidate test samples to expected forces due to installation and operational loadings.

44611 (AGA–9015612) **Effects of seasonal variations on requirements to prevent corrosion in soils: Final report.** Han, M.K. Battelle Columbus Div., OH (USA). c Dec 1988. 106p. Sponsored by Battelle Columbus Laboratories. (PR–3-505). Available from American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $50.00.

The objective of this research has been to examine the effects of seasonal variations, in soil moisture content, on the cathodic protection requirements to prevent corrosion of pipe steel in soils. The research consisted of four major tasks: Characterization of the Effects of Moisture Content; Characterization of the Effects of Cyclic Moisture Fluctuations; Cathodic Protection Requirements as a Function of Moisture Content; and Field Tests. Task 1 consisted of a series of laboratory experiments in which the electrochemical behavior of pipe steel in soils of different moisture contents were examined. Task 2 was concerned with evaluating, through another series of laboratory tests, the effects of seasonal moisture fluctuations on the electrochemical behavior of cathodically-protected pipe steel. Task 3 consisted of analyzing the results of Tasks 1 and 2. Task 4 was concerned with verifying the laboratory results, obtained in Tasks 1, 2, and 3, in the field. This verification was done by (1) comparing and correlating the laboratory results with available field data from other PRC funded projects and (2) performing a limited field test. It is concluded that cathodic protection requirements decrease with decreasing soil moisture content. The cathodic protection potential required to mitigate corrosion below a 1 mil per year rate, for instance, as found to be about -0.6 V, $Cu/CuSO_4$, in soils having 5 weight percent moisture content, which is 250 mV more positive than the recognized criterion of -0.85 V, $Cu/CuSO_4$. 39 figs., 5 tabs.

44612 (AGA–9015613) **Submarine pipeline on-bottom stability: Volume 1, Analysis and design guidelines: Final report.** Brown and Root U.S.A., Inc., Houston, TX (USA). c Nov 1988. 420p. Sponsored by American Gas Association. (PR–178-516;PR–178-717). Available from American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $250.00.

This report has been developed as a reference handbook for use in on-bottom pipeline stability analysis and design. It consists of two volumes. Volume one is devoted to descriptions of the various aspects of the problem: the pipeline design process; ocean physics, wave mechanics, hydrodynamic forces, and meteorogical data determination; geotechnical data collection and soil mechanics; and stability design procedures. Volume two describes, lists, and illustrates the analysis software. Diskettes containing the software and examples of the software are also included in Volume two. (115 refs., 127 figs., 7 tabs.)

44613 (NPA–C88-1-1988) **[Northern Pipeline Agency] annual report, 1987-1988.** Northern Pipeline Agency, Ottawa, ON (Canada). 1988. 37p. (In English and French). (MICROLOG–89-03792). Available from Northern Pipeline Agency, Lester B. Pearson Building, 125 Sussex Drive, Ottawa, ON, CAN K1A 0G2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Northern Pipeline Agency was established to facilitate the efficient and expeditious planning and construction of the Alaska Highway Gas pipeline in a manner consistent with the best interest of Canada. This report reviews the project and outlines developments that will affect operations of the pre-build and planning for second-stage construction of the pipeline. Financial statements for the Agency are also included. Major revisions in the second-stage pipeline design and substantially reduced cost estimates are outlined, which, combined with the improved market for natural gas, improve the chances for completion of the pipeline in the 1990s.

44614 (PB–89-204572/XAB) **Transmission operations research status report: 1987 projects.** Gas Research Inst., Chicago, IL (USA). Jul 1988. 65p. (GRI–88/0361). Available from NTIS, PC A04/MF A01.

A brief introduction explains GRI's coordinated transmission operations research program, which is managed primarily by the Transport and Storage Research department but also includes projects in three other departments. Reports summarizing the status of each active research contract are included for the following project areas: natural gas supply environment and safety research, combustion systems emission control, metering and operations, gas storage technology, metal transmission and distribution piping systems, transport environment and safety research, engine-driven cogeneration systems, industrial energy systems, and burner-systems development.

44615 (PB–89-207419/XAB) **System and material specifications for an advanced gas distribution system. Executive Summary, December 1987-December 1988.** Lipinsky, E.S.; Hattery, G.R.; Wenzel, A.E.; Millett, S.M. Battelle Columbus Div., OH (USA). May 1989. 17p. Available from NTIS, PC A03/MF A01.

See also PB–89-131155 and PB–89-207427.

From prior reports published during the study (GRI-88/0231 and GRI-88/0265), a view of the current distribution system and the potential gas sources and areas of demand were identified and projected to the year 2010. The final report utilizes these data to provide potential scenarios of what the gas distribution system of the future could entail. These scenarios and earlier analyses suggest that significant efficiencies to the system can be introduced by lowering the labor needed to install and service the system. Emphasis on evolutionary materials development is the recommended

method to developing the next generation system. An advanced material will meet performance criteria established by the study and will be compatible with the current system. The report concludes that the current system is being operated efficiently, safely and effectively by the distribution industry. The recommendations point toward programs that could be used to reduce costs while maintaining the excellent safety record. The document presents the executive summary of the titled research program. The companion unabridged report (GRI 89/0107.2) contains complete information.

44616 (PB–89-207427/XAB) **System and material specifications for an advanced gas distribution system. Phase 1. Final report, December 1987-December 1988.** Lipinsky, E.S.; Hattery, G.R.; Wenzel, A.E.; Millett, S.M. Battelle Columbus Div., OH (USA). May 1989. 121p. Available from NTIS, PC A06/MF A01.

See also PB–89-207419.

From prior reports published during the study (GRI-88/0231 and GRI-88/0265), a view of the current distribution system and the potential gas sources and areas of demand were identified and projected to the year 2010. The final report utilizes these data to provide potential scenarios of what the gas distribution system of the future could entail. These scenarios and earlier analyses suggest that significant efficiencies to the system can be introduced by lowering the labor needed to install and service the system. Emphasis on evolutionary materials development is the recommended method to developing the next generation system. An advanced material will meet performance criteria established by the study and will be compatible with the current system. The report concludes that the current system is being operated efficiently, safely and effectively by the distribution industry. The recommendations point toward programs that could be used to reduce costs while maintaining the excellent safety record.

0330 Properties

44617 Analytical instrument with apparatus for sample concentrating. Zaromb, S. To Dept. of Energy, Washington, DC. USA Patent 4,829,008. 9 May 1989. Filed date 4 Aug 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A system for analysis of trace concentrations of contaminants in air includes a portable liquid chromatograph and a preconcentrator for the contaminants to be analyzed. The preconcentrator includes a sample bag having an inlet valve and an outlet valve for collecting an air sample. When the sample is collected the sample bag is connected in series with a sorbing apparatus in a recirculation loop. The sorbing apparatus has an inner gas-permeable container containing a sorbent material and an outer gas-impermeable container. The sample is circulated through the outer container and around the inner container for trapping and preconcentrating the contaminants in the sorbent material. The sorbent material may be a liquid having the same composition as the mobile phase of the chromatograph for direct injection thereinto. Alternatively, the sorbent material may be a porous, solid body, to which mobile phase liquid is added after preconcentration of the contaminants for dissolving the contaminants, the liquid solution then being withdrawn for injection into the chromatograph.

0340 Combustion

Refer also to citation(s) 44500

44618 (PB–89-204028/XAB) **Ceramic-tube material and processing development: development of slip-cast and extruded-reaction-bonded silicon carbide components for gas-fired furnaces. Final report, February 1982-October 1987.** Roy, D.W.; Green, K.E.; Dobos, C.J. Coors Ceramics Co., Golden, CO (USA). Mar 1988. 149p. Available from NTIS, PC A07/MF A01.

Ceramic-component manufacturing technology for reaction-bonded silicon carbide was developed for production of large thin-walled components up to 8 inches in diameter and 8 feet in length. Available property data, component performance information, and cost estimates are presented. Accomplishments and results include: Optimization of body formulation, extrusion and slip casting procedures, and modifications to Coors siliconizing process has resulted in two consistent, high yield production processes. Property values obtained in full size components include densities of 3.08 g/cc, flexural strength of 58,000 psi at 2200 F (1200C), fracture toughness (K(Ic)) of 6.3 at 2200 F (1000 C) and thermal conductivity of 257 BTU in/hr/sq ft/F at 1832 F (1000 C). Initial component tests indicate SCRB-210 to be viable for numerous high-temperature radiant tube and heat exchanger applications. Tube price estimates indicate goals established at the onset of the program have been obtained.

0350 Storage

44619 (SV-UG–1989-13) **Water-tighting storage for natural gas. Water chemistry and water treatment.** Andersson, Oe.; Gustafson, G.; Schreiber, I. Swedish State Power Board, Vaellingby (Sweden). 1 Mar 1989. 27p. (In Swedish). Order Number DE89914802/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Natural gas storage in unlined caverns is controlled by an artificial recharge called a 'water curtain'. It is essential that no plugging arises in the injection system which would lead to loss in injection capacity. This lead to pressure drop and subsequent gas losses. This report accounts for the quality of deep groundwaters, i.e. at 500-800 metres depth, in chrystalline rocks and establishes the requirements of water quality for the injection system. Based on this a water treatment system and a monitoring schedule is suggested. Major water quality requirements of the injection water are that it should be reducing and oxygenfree and that the concentrations of suspended solids carbon dioxide and natural gas should be kept at low values. Furthermore the injection water must not contain any organic matter, the iron and manganese concentrations are also to be kept at low values and the pH is to be maintained at a lower value than equilibrium pH for calcite to avoid calcite precipitation in the system. The water treatment suggested uses the drainage water from the rock caverns as raw water for the injection. The water treatment plant is placed at 50 metres depth to avoid oxygen intrusion among other things. Before water treatment the water is shipped of methane. The first step of treatment is filtration to reduce the concentration of suspended solids. Water which precipitates calcium is then treated with ion exchanger or, less likely, by the addition of some ligand. The water is in the final step desinfected by the use of UV-radiation before the pressure is elevated and the water is returned to the injection system. Regularly scheduled system monitoring is essential to the efficient operation of any water injection system. This enables the early detection of any deterioration in water quality so that corrections can be made before serious damage to the system arises.

04 OIL SHALES AND TAR SANDS

Refer also to citation(s) 44462

0401 Reserves and Exploration

44620 (ISPG–8502) **Recommendations for the investigation of northern Canadian oil shale deposits.** Macauley, G. Institute of Sedimentary and Petroleum Geology, Calgary, AB (Canada). 1985. 21p. (CE–02765). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Three significant oil shale deposits in the Northwest Territories and Yukon are recommended for study as possible sources of local energy requirements. These include the Ordovician beds in Southampton Island, the Devonian Canol Formation of the Norman Wells area, and the Upper Cretaceous Smoking Hills-Boundary Creek Formations. Based on previous investigations as reported in the literature, this report describes the geographical and geological setting, interpreted stratigraphy, and oil shale distribution and quality in those three deposits, along with research recommendations. 43 refs., 6 figs., 2 tabs.

0402 Site Geology and Hydrology

Refer also to citation(s) 44859

0403 Drilling, Fracturing, and Mining

Refer also to citation(s) 44624

0404 Oil Production, Recovery, and Refining

Refer also to citation(s) 45201

44621 (TU/CEA–19881) **Numerical simulation of steam injection in bitumen and heavy oil reservoirs, phase 2, vol. 1.** de Buda, P.G.; Cormack, D.E. Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry. 1988. 102p. (MICROLOG–89-03119). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In research on numerical simulation of the steam injection/gravity drainage recovery process for bitumen and heavy oil deposits, work has been undertaken to develop a 2-dimensional simulator to track the location of the steam front explicitly within a finite-difference procedure, so that the phenomena at the steam front can be more accurately simulated. In particular, a so-called front-fixing method has been adopted which maps the steam front location onto a stationary surface through a time-dependent coordinate transformation. Details of the mathematical analysis required to incorporate this transformation are given, along with details of the finite-difference representation. The simulator was tested using physical properties typical of the Cold Lake deposits. The simulator predicted what seemed to be a physically realistic behavior for the initial stages of steam chamber development. However, the vapor saturation at the steam front on the ceiling of the chamber dropped rapidly towards the residual vapor saturation value. This behavior seems physically unreasonable, and is attributed to a deficiency in the finite-difference formulation of the steam front equations. The unique feature of the ceiling is the countercurrent flow which apparently cannot be properly accommodated by the simulator. A related problem with the simulator is that it is much slower than it should be, mainly because it requires too many iterations per time step. A modified approximation procedure has been proposed as a means of tackling this problem. 43 refs., 12 figs., 6 tabs.

44622 (TU/CEA–19882) **Numerical simulation of steam injection in bitumen and heavy oil reservoirs, phase 2, vol. 2: computer program listing and sample data for the simulator.** de Buda, P.G.; Cormack, D.E. Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry. 1988. 130p. (MICROLOG–89-03119). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A complete FORTRAN program listing is provided for a computer program designed to simulate steam injection of a bitumen/heavy oil deposit, with sample data supplied based on characteristics of Cold Lake bitumens. The program includes an implementation of a coordinate transformation/front fixing method, which maps the steam front location onto a stationary surface through a time-dependent coordinate transformation.

0405 Properties and Composition

44623 **Real-time, on-line determination of carbon monoxide using charge exchange with krypton in a triple quadrupole mass spectrometer.** Crawford, R W. (Lawrence Livermore National Lab., CA (USA)); Alcaraz, A.; Reynolds, J.G. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 33(3): 509-513 (Aug 1988). DOE Contract W-7405-ENG-48. (CONF-8809227–: American Chemical Society Division of Petroleum Chemistry, 25-30 Sep 1988).

Although the triple quadrupole mass spectrometer (TQMS) can be highly specific, as molecules becomes simpler, it is more difficult to create fragments that are unique. Carbon monoxide is an excellent case in point. It can form only two fragments, C^+ at m/z 12 and O^+ at m/z 16. Since any hydrocarbon fragment of mass 28 will have a daughter at m/z 12, the O^+ ion is the only specific ion from CO. Unfortunately, we have found this fragment to be low in intensity and not analytically useful under conditions optimal for generating daughters of most other parents. The TQMS is used in our Laboratory as an on-line analyzer for pyrolysis products from oil shale, tar sands and coal. Besides determining many hydrocarbon as well as ten sulfur-containing species, it is important to determine the major oxygen-containing products; H_2O, CO_2, CO and COS. CO is a particular challenge. It is impractical to remove the ubiquitous contribution of hydrocarbons to the ion at m/z 28 when using the normal MS mode and, as mentioned earlier, the daughter fragment at m/z 16 in MS/MS mode is unsatisfactory. An infrared detector specific for CO can be (and has been) connected to the same gas stream as the TQMS, but this forces additional calibration and maintenance. In addition, the volume of the IR cell introduces dispersion and reduced resolution. By replacing argon with krypton as the collision gas in the TQMS, a charge transfer reaction takes place with the CO^+ ion but not with hydrocarbon fragment ions of mass 28. Using MS/MS mode with an m/z 28 parent, the major isotope of Kr at m/z 84 was monitored; this charge exchange product was linearly proportional to CO^+.

0420 Regulations

44624 (ERCB–D88-10) **C-H Synfuels Ltd. application to construct an oil sands dredging project.** Energy Resources Conservation Board, Calgary, AB (Canada). [1989]. 24p. (CE–02768). Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

C-H Synfuels applied for approval to construct an oil sands dredging project in the Fort McMurray area of Alberta. The project is intended to assess the feasibility of mining oil sands by dredging, to test a proprietary extraction method, and to test the treatment of tailings to achieve rapid land reclamation. The criteria for the ideal site for the project include surface accessibility, presence of exposed oil sands that could be readily exposed in a configuration under water or that could be flooded, and absence of conditions under which dredging would be detrimental to the environment. The site selected was near the Horse River, where a cutoff meander would be dredged. A system of dikes would be constructed to ensure separation of the site from the river system. A hearing was held to consider the issues raised by construction of the project. The three main issues were considered to be the potential benefits of improved oil sands technology, the site selection criteria, and the effects of the project on the environment and the community. After considering the evidence presented, it was felt that the potential benefits of the project were such as to merit approval, provided that technical safety and environmental integrity can be attained. The site selected was considered acceptable provided that suitable security and other safety measures are in place. With reference to environmental impacts, factors such as noise and odors are not felt to be a problem, and surface water impacts would be subject to monitoring and protection measures administered by Alberta Environment. 3 figs.

05 NUCLEAR FUELS

0501 Reserves, Exploration, and Mining

44625 (IAEA-TECDOC–500) **Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.** International Atomic Energy Agency, Vienna (Austria). Mar 1989. 529p. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Since about the mid seventies, the International Atomic Energy Agency has held meetings on the geology and uranium resources of different geographic regions of the world. As a continuation of this series the Technical Committee Meeting on Uranium Resources and Geology of North America was held between 1-3 September 1987

in Saskatoon, Canada. The meeting took place in the University of Saskatchewan, hosted by the Department of Geological Sciences in cooperation with the Department of Energy, Mines and Resources Canada. Thirty-six technical papers were presented to a group of over 85 participants from seven countries. These papers provided an excellent coverage of uranium occurrences and deposits and their geological framework in Canada and the USA, with analogies from other parts of the world. North America, the region dealt with in this meeting, is of eminent significance for the world's uranium production and the nuclear industry. Total WOCA U-resources according to the classification developed by the IAEA and the Nuclear Energy Agency of OECD are periodically collected by these two organisations for their report on Uranium Resources, Production and Demand. Currently total WOCA known U resources recoverable at costs of less than $130/kg U or $50/lb U_3O_8 amount to 3.5 million t U, of which about 25% are located in North America, while the remainder is equally divided among Africa, Australia and the rest of WOCA (Asia, Europe, South America). Refs, figs and tabs.

44626 (IAEA-TECDOC–500, pp. 29-47) **Analysis of uranium discovery in Canada, 1930-1983: Rates of discovery, exploration expenditures, discovery costs and geological deposit types.** Cranstone, D.A. (Energy, Mines and Resources Canada, Ottawa, Ontario (Canada). Mineral Policy Sector); Whillans, R.T. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

In 1932, Canada emerged as the world's second important source of uranium and in 1958 became the major uranium producer. Surpassed by the United States in terms of uranium production in 1959, Canada retained its role as leading exporter. It was not until 1984, however, that Canada again became the western world's leading uranium producer. During the past 40 years, enormous market pressures, unprecedented in any other major mineral commodity, caused levels of uranium exploration and rates of discovery in Canada to fluctuate considerably. Blessed with a large and growing inventory of known high-grade deposits, Canada has maintained its status as leading uranium exporter and focus of international uranium exploration activity. With average discovery costs in Saskatchewan, Canada's foremost uranium-producing province, of $Cdn 1.53 per kilogram of uranium and the potential for many additional major discoveries, Canada is assured of being able to supply its own uranium needs and those of its customers well into the 21st century. (author). 7 figs, 4 tabs.

44627 (IAEA-TECDOC–500, pp. 49-79) **Conceptual genetic models for important types of uranium deposits and areas favourable for their occurrence in Canada.** Ruzicka, V. (Geological Survey of Canada, Ottawa, ON (Canada)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Conceptual genetic models for the formation of known Canadian uranium deposits, developed for the purpose of uranium resource evaluation, have been formulated for: (1) deposits of Lower Proterozoic pyritic quartz-pebble conglomerates; (2) deposits associated with Proterozoic unconformities; (3) uraniferous veins; (4) disseminated mineralization in orthomagmatic, anatectic and metamorphic rocks; (5) volcanogenic deposits; (6) sediment-hosted deposits; (7) surficial deposits; and (8) deposits of other types. In Canada all active mines and the bulk of presently known recoverable uranium resources are confined to deposits of the first two types, although deposits of the remaining types contain resources which may be recoverable in the future. The conceptual model for the Lower Proterozoic uraniferous pyritic conglomerates involves placer concentrations of uranium minerals in the oldest (>2.25 Ga) supracrustal rocks, derived from Kenoran granitoids, and deposited in pericratonic or intracratonic basins. Environments favourable for such deposits occur in pericratonic basins of the Southern Structural Province and in some intracratonic basins of the Churchill Structural Province. In the conceptual model for deposits associated with Proterozoic unconformities it is postulated that the uranium was also derived from Kenoran granitoid rocks (>2.5 Ga), was accumulated during subsequent sedimentary and magmatic processes (between 1.8 and 1.7 Ga), underwent major reconcentration by diagenetic processes combined with hydrothermal events related to emplacement of diabase dykes (between 1.3 and 0.8 Ga) and was rejuvenated in at least two later periods (at about 300 to 200 Ma and at about 80 Ma). Environments favourable for unconformity-associated uranium deposits in Canada occur in the Athabasca Basin, Baker Lake - Thelon Basin, Coronation Homocline and Otish Basin regions. (Abstract Truncated)

44628 (IAEA-TECDOC–500, pp. 81-82) **Review of genetic models for major types of uranium deposits in the USA.** Finch, W.I. (Geological Survey, Denver, CO (USA)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Abstract only.

44629 (IAEA-TECDOC–500, pp. 83-109) **Thrust-induced consanguinity in diverse genetic types of uranium deposits: North American and other examples.** Strnad, J.G. (Uranerz Exploration and Mining Ltd, Saskatoon, Saskatchewan (Canada)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

In comparison with the genesis of most mineral deposits, the tandem of source, transport, and precipitation has been given particular attention in the study of uranium metallogeny. Of these, transport is the member which has seen perhaps only a one-sided scrutiny. In the past, research has focused on the physico-chemical aspects of the fluids, with the structural environments through which the fluids advance remaining less specified. It is the tectonics s.l. which provides the link between the metal sources and the eventual area of precipitation. This paper centers on thrusts as a particularly important type of structural deformation. The combinations of differing permeabilities and varying fluids contents and compositions within the thrust-bound blocks with specific types of thermal gradients have led to increased anisotropy and triggering of the formation of localized hydrothermal cells. Sources of various kinds, variable lithologies, differing stratigraphies and distinct metamorphic grade could all be involved within the thrust domain. Obviously, these diverse environments produce or substantially contribute to the contrasting and numerous "genetic" types of uranium deposits: conglomeratic, albitite, unconformity, intra- and peribatholitic, etc. The differing genetic types of deposits might be seen as converging to some degree through the involvement of more universal processes, as for example by a unifying metallotect: the thrust. Thrusts, therefore represent particular controlling structures and targets (s.l.) in uranium exploration. (author). 49 refs, 2 figs.

44630 (IAEA-TECDOC–500, pp. 111-147) **Blind River (Elliot Lake) uranium deposits.** Robertson, J.A. (Ontario Ministry of Northern Development and Mines, Toronto (Canada). Mineral Development and Lands Branch). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

In the Blind River area Proterozoic sedimentary and minor volcanic rocks (Huronian Supergroup) unconformably overlie and

trangress northwards over dominantly granitic Archean terrain (2500 + Ma) and are intruded by Nipissing Diabase (2115 Ma). Later deformation and metamorphic events are recognized. The developing depositional basin was controlled by the incipient Great Lakes Tectonic Zone marginal to the Algoman Craton. The Matinenda Formation (basal Huronian) comprises northwards-derived fluvial arkose, quartzite, and pyritic, uraniferous oligomictic conglomerate containing half of Canada's recoverable uranium resources. Production to December 1986 comprises 123,000 tonnes U (average recovered grade 0.093% U) and minor amounts of Th and Y. An additional 752 tonnes U were produced by leaching at Agnew Lake. The conglomerate beds lie in southeasterly-striking zones controlled by basement topography down sedimentation from uraniferous Archean granite. Uraninite textures, monazite distribution, and local reworking indicate placer deposition. "Brannerite" formed by solution of uranium from uraninite grains and redeposition on titaniferous minerals. Some pyrite may be detrital, some authigenic and some introduced during mafic volcanic and intrusive activity. Kerogen in layers locally present at the top of conglomerate beds may represent algal mats which entrapped uraninite grains. Similar uraniferous deposits occur at Agnew Lake and in the basal Huronian north of Sudbury, where trace gold values reflect the local source area. Provenance, lack of complete oxidation, water transportation and deposition, diagenetic redistribution, and the lack of post-depositional destructive processes are the dominant factors in the formation and preservation of the ores. The modified placer theory of genesis for the deposits is widely accepted. 96 refs, 17 figs, 4 tabs.

44631 (IAEA-TECDOC–500, pp. 149-169) **Conceptual model for development of megabreccias and associated mineral deposits in Wernecke Mountains, Canada, Copperbelt, Zaire, and Flinders Range, Australia.** Bell, R.T. (Geological Survey of Canada, Ottawa, ON (Canada)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Wernecke Mountains in Canada, compare with the Copperbelt in Zaire and with the Flinders Range in Australia in having areas of megabreccias with horizontal extent in the tens of kilometres and with clasts predominantly of sedimentary rocks, some greater than kilometre-size. Mineral deposits occur as older stratiform sedimentary of diagenetic mineralizations within the blocks, as veins and alteration zones associated with emplacement of the breccias and as supergene veins and crusts. The strong elemental signatures are: Cu, Co, U, Fe and Ba with weaker signatures including Pb-Zn, Au, Ag, Mo, REE, or Pt-Pd. For the above mineral deposits a general conceptual model proposed is: (a) sedimentary/diagenetic concentration in closed basins in association with marine or lacustrine evaporite facies; (b) after burial these sediments and earlier stratiform deposits were mechanically and chemically transported upwards during diapiric action; and (c) breaching, exposure and later weathering permitted removal of the evaporite minerals, some slumping and development of supergene crusts. The amount and degree of study and attendant economic mineral development in these areas vary considerably. 58 refs, 13 figs.

44632 (IAEA-TECDOC–500, pp. 171) **Formation of infiltration-type uranium deposits associated with granitic and metamorphic basement complexes - Exploration guidelines.** Boyle, D.R. (Geological Survey of Canada, Ottawa, ON (Canada)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Abstract only.

44633 (IAEA-TECDOC–500, pp. 173-190) **Green Mountain uranium district, Central Wyoming: Type locality of solution front limb deposits.** Klingmuller, L.M.L. (Pathfinder Mines Corp., Riverton, WY (USA)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Green Mountain uranium district, an up to 24 km (15 miles) long and 4 km (2.5 miles) wide area contains known mining-diluted reserves in excess of 70 million pounds U308, ranging in grade from 0.20% to 0.23% U308. As of yet, undefined resources could approach an additional equal amount. The host rock for these reserves is the Eocene Battle Springs formation, an over 1,500m (5,000 feet) thick sequence of continental fluvial deposits consisting of arkosic sandstones, conglomeratic sandstones, and siltstones. The Granite Mountains, an ancient crystalline high, supplied the detritus for both the Battle Springs formation to the south and the Wind River formation of the same age to the north. The latter area contains the Gas Hills uranium district. Despite source rock and age similarities, remarkable differences exist between the districts in respect to the morphological habit of uranium concentrations. Significant uranium mineralization in the Green Mountain district occur at the interface between carbonaceous trash-rich siltstone lenses, acting as reducers, and the more permeable arkosic sandstone and/or the conglomerates. Where a high frequency of these interfaces exist and oxidizing waters penetrated these reducing siltstones, economically significant deposits can occur. Based on drill log data, it is postulated here that the uranium of Battle Springs formation was originally introduced into the sediments during deposition or very shortly thereafter. A regional redox cell known to extend over a stratigraphic thickness in excess of 1,200m (4,000 feet), concentrated the intraformational uranium when surface water during a later erosional cycle could penetrate the Battle Springs formation. Locally, these redox cells with high grade limb deposits are very complex because aquicludes are absent. (author). 13 refs, 17 figs, 2 tabs.

44634 (IAEA-TECDOC–500, pp. 191-200) **Uranium roll-front deposits in the southern Black Hills, South Dakota.** Scofield, N. (South Dakota School of Mines and Technology, Rapid City, SD (USA). Inst. of Mineral Deposits); Faircloth, S.; Blake, B.; Laul, J.C. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

In the southern Black Hills of South Dakota, uranium roll-type deposits are present in early Cretaceous Lakota Formation sandstone. Analysis of a 45-Foot drill core, representing a vertical section through the nose of the roll-front, by scanning X-ray fluorescence (XRF), standard XRF, X-ray diffraction (XRD), organic petrography, electron microprobe, and scanning electron microscopy (SEM) is underway. The core is lithologically composed of an orthoquartzite with varying amounts of chert and consists of an oxidized zone, four reduced zones, and three ore zones. The oxidized zone is characterized by medium to fine-grained, well-sorted, well-rounded orthoquartzite with minor hermatitic kaolinite weakly cementing and coating quartz grains. Reduced zones have medium to fine-grained gray to black quartz grains; coarse-grained, angular, white to black chert; thin laminae and small isolated fragments of carbonaceous material with pyrite. Ore zones are composed of poorly-cemented, well-sorted mixtures of rounded quartz grains and angular to rounded chert with yellow to olive-green uranium- and vanadium-rich clays, and carbonaceous material with pyrite. The chemistry of the entire core was determined by scanning X-ray fluorescence for 46 elements. In the oxidized, reduced, and ore zones, uranium and vanadium averaged 40 ppm U and 3300 ppm V, 800 ppm U and 3000 ppm V, and 3800 ppm U and 5000 ppm V, respectively. No uranium or vanadium minerals have been found by XRD or microprobe analysis. However, certain segments of the core are enriched in U and V, including those with high clay content. Preliminary SEM analyses have shown smectite, kaolinite, and possibly illite as coatings on quartz grains. U and V are present in some of the clay

coatings, and probable carnotite and an authigenic vanadium mineral were found. Carbonaceous laminae are present in the reduced and ore zones and commonly contain pyrite with associated uranium.

44635 (IAEA-TECDOC–500, pp. 201-225) **Hematite-enriched sandstones and chromium-rich clays - Clues to the origin of vanadium-uranium deposits in the Morrison Formation, southwestern Colorado and southeastern Utah, USA.** Breit, G.N. (Geological Survey, Denver, CO (USA)); Goldhaber, M.B. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Fluvial sandstones of the Salt Wash Member, Upper Jurassic Morrison Formation, southwestern Colorado and southeastern Utah, host tabular, epigenetic vanadium-uranium (V-U) deposits. Laterally within a few tens of meters of some of the V-U deposits are two distinct accumulations -one enriched in iron (hematite), and the other chromium (Cr-rich mixed-layer clays). The iron-enriched sandstones commonly occur at the contact between red and gray (buff in outcrop) sandstones, are dark red and generally color banded. Between the iron and V-U deposits, chromium accumulated in gray argillaceous sandstones that contain small coalified plant fragments. Variations in Eh, oriented parallel to facies changes but perpendicular to regional ground-water flow, controlled the spatial distribution of iron, chromium, and V-U deposits. Depositional facies within the Salt Wash Member are characterized by fluvial axes containing thick sandstones, and by well-drained floodplains marginal to the fluvial axes. Laterally continuous sandstones contained an organic acid bearing solution that mobilized iron as Fe(II). This reducing solution mixed with alkaline U-, Cr-, and V-bearing, oxygenated pore waters from floodplain sediments. Due to mixing, dissolved iron in the reducing solution was oxidized and precipitated as ferric hydroxide. Chromium, as chromate (CrO_4^{2-}), was chemically reduced by organic compounds in the vicinity of minor accumulations of detrital plant fragments and was incorporated into authigenic clay minerals. Dissolved U and V were not reduced by the organic compounds; instead, reduction and precipitation occurred by reaction with localized strongly reducing (sulfidic) pore waters. The tabular geometry of V-U deposits was a product of the hydrologic characteristics of the host rock or a brine-freshwater interface. (Abstract Truncated)

44636 (IAEA-TECDOC–500, pp. 227-238) **Diagenesis and ore deposition in sandstone-hosted uranium-vanadium deposits in the Colorado Plateau: Evidence from fluid inclusions.** Meunier, J.D. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

In order to better understand the diagenetic history of the U-V mineralization in the Morrison Formation of the Colorado Plateau, fluid inclusions trapped in authigenic calcites have been investigated. In the Cottonwood Wash district, Lisbon Valley area, Slick Rock district and Grants uranium region, fluid inclusion data indicate that temperatures near 100 deg. C have been reached. These temperatures correspond to maximum diagenesis of the host rocks. In the Lisbon Valley fault, fluid inclusions in calcite co-genetic with copper deposits contain solutions of variable salinities. Similar solutions were also present in the Slick Rock district. These solutions may have precipitated the vanadium chlorite, or influenced chlorite formation by recrystalization. In the Grants uranium region, fluid inclusion data support the model of Hansley on the alteration of primary ore deposits during maximum diagenesis and formation of altered ore. (author). 20 refs, 5 figs, 1 tab.

44637 (IAEA-TECDOC–500, pp. 239) **Geothermal analyses of the breccia pipes (Arizona) - Organic matter, fluid inclusions, fission tracks and computerized modeling.** Landais, P. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)); Meyer, A.; Forbes, P.; Carisey, J.C.; Krewedl, D.A.; Brosse, E. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Geothermal characterization of sedimentary uranium deposits has frequently been carried out using geological data (burial, erosion, faulting...). Organic matter has also been used as a geothermometer but, considering its involvement in oxidation, the chemical composition of oils, coals or kerogens is not always representative of the thermal maturation. More recently fluid inclusions have been analyzed by microthermometry in several sedimentary deposits. Nevertheless, problems concerning leakage, necking or reequilibration phenomena can disturb the geothermal diagnosis. Furthermore organic matter gives an integration of the time-temperature effects while fluid inclusions represent temperature peaks. This is why a complete geothermal study including the analyses of fission tracks in apatite has been carried out on the Arizona pipes of the Grand Canyon region (Arizona). Results have been compared to geological data and computerized on two thermal modeling programs at the Institut Francais du Petrole (organic matter) and at the C.R.E.G.U. (fission track). Brecciated rocks inside the pipe throat and samples from undisturbed formations have been analyzed. Interpretations give important data on the maximum temperatures, thermal history, time of erosion in this uraniferous area. (author).

44638 (IAEA-TECDOC–500, pp. 241-261) **Flodelle Creek surficial uranium deposit, Stevens County, Washington, USA.** Otton, J.K. (Geological Survey, Reston, VA (USA)); Zielinski, R.A.; Johnson, S.Y. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

A recently discovered uranium deposit occurs in surficial, organic-rich, low radioactivity sediments of late Pleistocene to Holocene age. Its study provides a geologic model for locating other young, and therefore daughter-poor, uranium deposits. The uranium is concentrated in valley-fill sediments that are as much as 4 m thick along the north fork of Flodelle Creek in Stevens County, Washington. These sediments range from mucky peat (50 to 60 wt. percent organic matter) to clay, silt, and sand of lesser organic content. They were deposited in shallow ponds, on flood plains, or in stream channels along the valley floor of the drainage. Uranium content of the sediments ranges from <0.01 to 0.9 percent by dry weight and is positively correlated with content of organic matter. Local bedrock is Cretaceous two-mica quartz monzonite that is anomalously uraniferous; 28 outcrop samples average 5.9 +- 4.2 ppm U and 13 core samples average 15.8 +- 2.7 ppm. U. The bedrock is locally fractured and faulted and is mostly covered on hillslopes by as much as 2 m of sandy glacial till. Transport of uranium from this local source rock to nearby organic-rich sediments is via anomalously uraniferous (17-320 ppb U) surface and ground waters, and via springs that issue from till-covered slopes or that discharge into valley bottom sediments from below. Recent glaciation appears to have been critical to the establishment of this mineralizing system because it simultaneously provided (1) renewed exposure and comminution of a favorable source rock and (2) formation of environments suitable for water ponding and plant growth so organic-rich sediments could accumulate and act as traps for dissolved uranium. (author). 37 refs, 5 figs.

44639 (IAEA-TECDOC–500, pp. 263-296) **Regional lithogeochemistry of the eastern part of the Athabasca Basin uranium province, Saskatchewan, Canada.** Earle, S.A.M. (Saskatchewan Mining Development Corp., Saskatoon, SK (Canada)); Sopuck, V.J.

International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Data from 6500 core samples from exploration drill holes have been studied in a compilation of the lithogeochemistry of the eastern part of the Athabasca Basin uranium province, Saskatchewan. Both regional and deposit-scale lithogeochemical patterns in the Helikian Athabasca Sandstone and underlying basement rocks have been assessed, using lithogeochemical plans and cross-sections. Uranium deposits in the study area (eg. Key Lake, Cigar Lake) have alteration halos which extend through the overlying sandstone. The alteration halos are characterized by illitization, kaolinitization and dravitization as well as trace element enrichment. Very large regional alteration patterns have also been outlined. The results have been applied to exploration programs, and have been used to assist in our understanding of the ore deposits. (author). 26 refs, 18 figs, 2 tabs.

44640 (IAEA-TECDOC–500, pp. 297-319) **Uranium deposits in the Beaverlodge area, northern Saskatchewan: their relationship to the Martin Group (Proterozoic) and the underlying basement.** Mazimhaka, P.K. (Saskatchewan Unvi., Saskatoon (Canada). Dept. of Geological Sciences); Hendry, H.E. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The rocks of the Martin Group crop out in an area 60 km by 50 km north of Lake Athabasca near Uranium City, northern Saskatchewan. This area has numerous uranium showings within a few kilometres of the unconformity below the Martin Group. Mineralization occurs in fault zones, in basement rocks and in sedimentary and volcanic rocks of the Martin Group. Martin Group sediments accumulated in alluvial fans, braided streams, and ephemeral lakes. The thickest sequence (8 km to 10 km) is preserved in the Beaverlodge area, near Uranium City. The style of sedimentation changed through time as the basin evolved from deposition of conglomeratic detritus along fault scarps to the accumulation of silt in ephemeral lakes. The uneven nature of the sub-Martin unconformity surface, the lithotype of the lowermost conglomerates and breccias (Beaverlodge Formation), and the shape of the basin fill indicate deposition in fault-controlled basins. The earliest economic uranium mineralization in the rocks of the Martin Group was epigenetic. The mineralization was coeval with that in basement rocks. Economic mineralization in basement rocks and in the lowermost formation of the Martin Group is close to the unconformity. Epigenetic uranium mineralization thus appears to have resulted from processes that were related, in time and space, to either the formation of the unconformity or the deposition of the Martin Group or both. (author). 29 refs, 5 figs.

44641 (IAEA-TECDOC–500, pp. 321) **Basement geochemistry and possible links between 'Beaverlodge' and 'Athabasca' type uranium mineralization.** Parslow, G.R. (Regina Univ. (Canada). Dept. of Geology). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Regional studies of the distribution of U, Th, and K in the Saskatchewan Shield do not reveal any obvious zones of radioelement enrichment that may have acted as precursors, and thus sources, for the uranium deposits of the Beaverlodge vein type or the higher grade Athabasca unconformity type. On the other hand, uranium enriched granites (HHP or high heat production granites) have been identified in the general area. Using the model of HHP granites as long term heat pumps affecting the groundwater flow regimes and tectonics as the factor controlling rock permeability, a relationship between the Beaverlodge and Athabasca type deposits can be proposed and also the periodic remobilizations of uranium minerals within the deposits can be explained. (author).

44642 (IAEA-TECDOC–500, pp. 323) **Geochemistry in Athabasca Basin exploration, Canada.** Clark, L.A. (Clark Geological, Saskatoon, Saskatchewan (Canada)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Background for uranium in centre lake sediment samples is about 1 ppm in a range of 0.5 to 3, although values in the 100s of ppm are occasionally found in till areas rich in granite boulders. Careful work in areas near known subAthabasca uranium deposits generally gives values less than 2.5 ppm which are difficult to distinguish from background variations. Soil radon data are erratic due to granitic boulders in the sandy till. Soil sampling is hampered by leached, very sandy soils and acidic pine humus. Uranium scavenging in bogs, occasionally to over 1%, occurs rarely in the less sandy basement areas. Dunn (1983) showed that uranium in black spruce twig ash exceeds 100 ppm in a 500 km^2 area centred on the Rabbit Lake deposits within a 5000 km^2 area of greater than 10 ppm. Drill core lithogeochemistry shows well defined haloes in the basement and extending vertically through the overlying sandstone to surface (Sopuck, et al., 1983). An alteration chimney at least 200 m wide extends to subcrop nearly 200 m above the Midwest deposit and contains 2 to 13 ppm uranium, up to 100 ppm boron, and K_2O:Al_2O_3 ratios of 0.10 to more than 0.15. As exploration is now most active in areas with 500 to 800 m of sandstone cover, the cost of drill holes to test the basal unconformity is enormous. A lithogeochemical technique to map the subcrop of the alteration chimney with drill holes 10 m into sandstone was devised by Clark (1985, 1987). In an orientation survey, well developed anomalies were defined 400 to 430 m vertically above the Cigar Lake deposit. Total and leachable uranium are 8 to 13 times the background values of 1.3 and 0.4 ppm, respectively. Other elements 4 to 8 times background, in order of intensity, include V, Zn, Sr, Y, Pb, Th, As and P. Na_2O has a pronounced negative anomaly. At the Dawn Lake deposit, the strongest subcropping anomalies are in boron and MgO. (author).

44643 (IAEA-TECDOC–500, pp. 325-338) **Jabiluka and Ranger uranium deposits, Australia - implications for genesis of unconformity-type deposits.** Nutt, C.J. (Geological Survey, Denver, CO (USA)); Grauch, R.I.; Frishman, D. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Jabiluka and Ranger unconformity-type uranium deposits, Northern Territory, Australia, share a similar geologic setting and suite of alteration minerals, but Ranger is approximately 300 million years older than Jabiluka. At Ranger, the U-Pb isotopic age indicates that mineralization preceded deposition of the clastic sediments of the middle Proterozoic Kombolgie Formation that overlie a regional unconformity. In contrast, the U-Pb isotopic age at Jabiluka is clearly younger than that of the Kombolgie Formation. The Jabiluka deposit is the larger of the two deposits and may contain uranium that was remobilized from smaller Ranger-like deposits. The alteration zones at Jabiluka and Ranger are similar and contain many of the minerals found in the altered zones around Canadian unconformity-type deposits: magnesium-rich chlorite that has low oxide and cation totals, white mica, dravite, quartz, apatite, carbonaceous matter, and at Jabiluka, 7A-amesite. At both Jabiluka and Ranger, the overlying sandstone of the Kombolgie Formation is altered. Our study indicates that unconformity-type deposits formed

during both the early and middle Proterozoic eras, and that, for deposits such as Ranger, the presence of the middle Proterozoic sandstone was not necessary for ore concentration. The presence of altered sandstone at Ranger indicates that in unconformity-type deposits, fluids repeatedly moved through the deposits. In contrast to the Canadian deposits, the fluid moving through the Australian deposits did not deposit significant amounts of uranium in the middle Proterozoic sandstone. 21 refs, 7 figs.

44644 (IAEA-TECDOC–500, pp. 339) **Similarities and differences between unconformity-spatially related uranium deposits from Aveyron, France, and Saskatchewan, Canada.** Pagel, M. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.
Abstract only.

44645 (IAEA-TECDOC–500, pp. 341) **Geology and genesis of the Athabasca basin uranium deposits.** Sibbald, T.I.I. (Saskatchewan Energy and Mines, Regina (Canada). Mineral Development Branch). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.
Abstract only.

44646 (IAEA-TECDOC–500, pp. 343) **Alteration halo characteristics of uranium deposits in the Athabasca Basin, northern Saskatchewan.** Earle, S.A.M. (Saskatchewan Mining Development Corp., Saskatoon, SK (Canada)); Sopuck, V.J. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Most of the uranium deposits in the eastern part of the Athabasca Basin of northern Saskatchewan are situated at the unconformable contact between Helikian quartz sandstones of the Manitou Falls Formation (Athabasca Group), and Aphebian metasediments of the Wollaston fold belt. The main post-diagenetic matrix mineral of the Manitou Falls Formation is kaolinite, but hydrothermal alteration processes associated with unconformity-type uranium mineralization have lead to pronounced alteration of the sandstone matrix. In the northern part of the district, around deposits such as Cigar Lake and Midwest Lake, kaolinite has been replaced by illite, and - immediately adjacent to ore - by chlorite. These illite "chimneys" are 100 to 200 metres wide, and they extend vertically through up to 400 metres of sandstone. In the southern part of the district, at Key Lake for example, the zone of illite alteration is much larger, apparently up to 10 kilometres wide. The sandstone immediately above mineralization is illite-poor because illitization has been inhibited by earlier dravitization and silicification. This illite alteration zone forms part of a regional illite anomaly which extends for several tens of kilometres northeast from Key Lake, and circumscribes all of the known uranium mineralization in the southeastern part of the Athabasca Basin. The central axis of this anomaly is characterized by dravitization and chloritization of the sandstone. The clay-mineral alteration characteristics of the Manitou Falls Formation have important implications concerning the temperature and composition of diagenetic and hydrothermal fluids. Furthermore, a knowledge of the distribution of such alteration zones, some of which can be detected at the top of the Athabasca sandstone, is an important tool for uranium exploration in the basin. (author).

44647 (IAEA-TECDOC–500, pp. 345-355) **Graphite disordering during the Gneissic basement alteration in the Saskatchewan uranium deposits (Canada).** Dubessy, J. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)); Landais, P.; Wang, A. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Unconformity type uranium deposits in Northern Saskatchewan are frequently associated with graphite-rich Proterozoic gneisses. At the Athabasca Basin scale, a spatial relationship between graphitic basement rocks and uranium ore deposits has been noticed. During the hydrothermal alteration related to the mineralizing process, a progressive removal of graphite can be observed when approaching the unconformity. In the mineralized zones the graphite totally disappears and is partly replaced by blebs of carbonaceous material. Study of the graphite alteration has been undertaken by sampling a series of specimens at various distances from the unconformity. X-ray diffraction, reflectance measurents, Raman spectroscopy, high resolution, transmission electron microscopy (HRTEM) and scanning electron microscopy (SEM) have been used in order to characterize the graphite structural parameters. Results indicate that a disordering of the graphite layers progressively increases with decreasing distances to the unconformity. Structural defects have been evidenced on Raman spectra while micro-diffraction spectra (HRTEM) show that almost amorphous carbon phases develop inside graphite flakes near the unconformity. Furthermore circular holes have been observed in graphite. They are surrounded by poorly organized carbon phases and could correspond to radiation damages. Emphasis has also been laid on the relationships between the graphite alteration and the occurrence of carbonaceous material containing hydrogen and oxygen in the mineralized areas. (author). 17 refs, 8 figs.

44648 (IAEA-TECDOC–500, pp. 357-358) **Alterations in the Carswell structure (Saskatchewan, Canada): Petrology, mineralogy and stable isotopes geochemistry.** Halter, G. (Centre de Recherches sur la Geologie de l'Uranium (CREGU), 54 - Vandoeuvre-les-Nancy (France)); Pagel, M.; Sheppard, S.M.F.; Weber, F. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.
Abstract only.

44649 (IAEA-TECDOC–500, pp. 359) **Hydrogeochemistry and uranium fixation in the Cigar Lake uranium deposit, northern Saskatchewan.** Cramer, J.J. (Atomic Energy of Canada Ltd., Pinawa, Manitoba (Canada)); Vilks, P. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The 1.3 billion year old Cigar Lake uranium deposit, discovered by COGEMA in 1981, is a very rich and large mineralization of uraninite-pitchblende and coffinite in the Athabasca Sandstone in northern Saskatchewan. The mineralization occurs at the -450 m deep unconformity contact of the sandstone with the underlying high-grade rocks of the basement. The sandstone, particularly its basal unit, is the regional aquifer and, due to permeability caused by extensive fracturing, groundwater is found in all parts of the deposit. The composition of this groundwater has been studied in detail over the past 3 years. The compositions of the groundwaters from different parts of the deposit reveal a reduced, redox-buffered, steady-state system of water interaction with the ore and host rock.

All groundwaters, including those in contact with the mineralization, are dilute, neutral pH waters containing low concentrations of dissolved uranium ($\sim 10^{-7.9}$ to 10^{-9} mol/L U). Concentrations of dissolved radium-226 and radon-222 are also low except in groundwaters sampled within the ore zone. The redox chemistry is controlled by a number of different processes, including inorganic and organic reactions, bacterial activity and radiolysis of water in the ore zone. The iron-redox couple is the main process controlling the redox conditions in the present dynamic system. The formation of iron colloids in the ore zone and the retention of these colloids in the bordering clay zone restrict the migration of naturally occurring radionuclides, such as uranium, thorium and radium, from the ore. Information from the redox, colloid and isotope chemistries is used to discuss the history of uranium fixation in this deposit. (author).

44650 (IAEA-TECDOC–500, pp. 361) **Lead and uranium isotopes in groundwaters around the Cigar Lake uranium deposit (Saskatchewan, Canada): Preliminary results.** Toulhoat, P. (CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Inst. de Recherche Technologique et de Developpement Industriel (IRDI)); Beaucaire, C. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Fourteen piezometers around the Cigar Lake uranium deposit (Northern Saskatchewan, Canada) have been sampled in July 1985 for lead and uranium isotope studies. The principal aim of this study was to test new methods of prospecting for concealed uranium ore deposits from groundwater analyses, that could be effective even in reducing conditions, which do not allow the appearance of U anomalies in groundwaters. The solubility of lead is not influenced by redox condition, but by the presence of complexing ligands (mainly carbonates and chlorides). The search for ^{206}Pb anomalies in groundwaters is thus a potential tool that is likely to be rather independent of oxido-reduction conditions. Total lead (dissolved + particulate phase-bound) has been analysed. Significant ^{206}Pb anomalies are found in waters that have been sampled in mineralized drill-holes. The most important anomaly is found in drill hole W-91, in which the extension of the mineralization is maximum. An interesting point is that in some cases where clear ^{206}Pb anomalies are found, (W=77, W-137), U concentrations are not anomalous. The efficiency of this method for the prospecting of uranium in reducing conditions is thus proved. $^{234}U/^{238}U$ activity ratios are low (between 1 and 2) in groundwaters from mineralized drill-holes. This was not expectd since $^{234}U/^{238}U$ activity ratios are generally high in reducing groundwaters especially around uranium mineralizations. Different explanations can account for these results: (1) the mineralization is very massive so ^{234}U access to the fluid phase after recoil or selective leaching is difficult; (2) the extremely reducing conditions encountered in this deposit cause very rapid reprecipitation or sorption of ^{234}U; (3) ageing is important relatively to other parameters, and causes a tendancy to reequilibration between ^{238}U and ^{234}U. (author).

44651 (IAEA-TECDOC–500, pp. 379) **Alteration parageneses of the Helikian sandstone and the Aphebian basement of the Key Lake mine and other uranium deposits in the eastern Athabasca basin (Saskatchewan, Canada).** Hubregtse, J.J. (Saskatchewan Mining Development Corp., Saskatoon, SK (Canada)); Sopuck, V.J. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.
Abstract only.

44652 (IAEA-TECDOC–500, pp. 381-409) **Age determination of basement units in the Key Lake uranium deposit area, Saskatchewan, Canada.** Hoehndorf, A. (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hannover (Germany, F.R.)); Carl, C.; Strnad, J.G. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Key Lake area is situated in the Churchill Structural Province of the Canadian Shield. It lies along the western side of the Wollaston Domain within the transition zone to the more highly metamorphosed Mudjatik Domain. The basement rocks in the Key Lake area consist of granite gneiss complexes which are unconformably overlain by Aphebian supracrustals. During the Hudsonian Orogeny both units were folded and metamorphosed forming NE striking elongated antiforms. The granite gneiss complexes are assumed to be of Archean age based on lithostratigraphic differences to the overlying Aphebian, but until now only a few radiometric age determinations confirmed this assumption because of the intense Hudsonian overprinting within the whole of the Wollaston Domain. For the granitoid antiform 3 km NW of the Key Lake uranium deposit a Kenoran age of 2.60 +- 0.06 Ga has been obtained by Rb/Sr whole rock determination. The same samples yielded 2.7 +- 0.8 Ga by Sm/Nd whole rock determination. This age complements a similar zircon crystallization age (2600 +- 18 Ma) of the Zimmer Lake antiform SE of Key Lake (Krogh and Clark, 1987) and supports the only other Archean Rb/Sr age at the mineralized sites in the Wollaston Domain found at the Midwest uranium deposit (2613 +- 93 Ma: Worden et al., 1985). Biotites and hornblende from the same granitoid antiform (NW of Key Lake) document the Hudsonian event by concordant K/Ar dates of 1723 +- 5 Ma for biotites and 1759 +- 10 Ma for hornblendes. (author). 36 refs, 5 fig, 3 tabs.

44653 (IAEA-TECDOC–500, pp. 363-377) **Structural and hydrothermal modification of the Gaertner uranium deposit, Key Lake, Saskatchewan, Canada.** Ruhrmann, G. (Key Lake Mining Corp., Saskatoon, Saskatchewan (Canada)); Pechmann, E. von. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Key Lake uranium deposits are located at the southeastern edge of the Athabasca Basin, approximately 240 km north of La Ronge, Saskatchewan. Key Lake Mining Corporation is at present the world's largest uranium producer with an annual rated production of approximately 12 million pounds of U_3O_8. The Gaertner deposit consists of massive aggregates of uranium and nickel minerals immediately above the Early/Middle Proterozoic unconformity at its intersection with the Key Lake structural zone. The main ore minerals are uraninite and coffinite which are accompanied by Ni-arsenides, Ni-sulpharsenides and Ni-, Fe-, Pb-, Co- and Cu-sulphides. Radially textured anisotropic uraninite in the Gaertner deposit represents the oldest mineralization phase dated at 1255+-12 Ma. A series of tectonic events and accompanying hydrothermal mobilization and alteration resulted in modifications of the original monomineralic uranium orebody. Based on ore microscopic examinations and field observations in the Gaertner open pit, the following modification stages are identified: 1. ~900 Ma: Fracturing of radially textured anisotropic uraninite, the oldest recognised uranium ore, subsequent introduction of Ni, As, S, Fe, Co and Cu. Radiometric dating of associated coffinite indicates an age of approximately 900 Ma. 2. ~300 Ma: Renewed fracturing of the nickeliferous uranium ore stockwork, hydrothermal carbonate and clay alteration with dispersion of mobilized elements into the wall rocks, and multiple redistribution/introduction of U under varying physicochemical conditions. On the basis of isotropy and optical reflectivity, four uraninite/pitchblende generations are distinguished in addition to a second nickel mineral suite and a coffinite phase. 3. <300 Ma: Vertical offset within the deposit under shallow conditions. Hydrothermal activity is not apparent. (author). 13 refs, 10 figs.

44654 (IAEA-TECDOC–500, pp. 411-428) **Geology and uranium potential of the Thelon basin and adjacent basement in**

comparison with the Athabasca basin region. Gandhi, S.S. (Geological Survey of Canada, Ottawa, ON (Canada)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Thelon basin is a Paleohelikian intracratonic basin similar to the Athabasca basin in tectonic setting, age and depositional environments. The two basins are 300 km apart and lie on basement that was affected by the Hudsonian orogeny ca. 1900 Ma ago. They contain mostly siliciclastic sediments, which are little disturbed and have a preserved thickness of over 1 km. The present areal extent of each basin is about 85,000 km^2. The sedimentation began approximately 1700 Ma ago according to isotopic dates on authigenic apatite in sandstones and on zircon in older rocks. Thick lateritic paleoregolith is preserved under the sandstones. Diabase dykes of the Mackenzie swarm intruded the sandstones approximately 1250 Ma ago. Uranium exploration in the Thelon basin region has not been as intensive as that in the Athabasca basin region, mainly because of relative remoteness and exclusion from exploration of a large area covered by the Thelon Game Sanctuary. Nevertheless, several promising prospects and numerous occurrences have been discovered. These represent various types of uranium deposits found in the Athabasca basin region, considered broadly under the stratabound, granite-related and vein-type in the basement rocks and the unconformity-related type at the base of Paleohelikian sandstone. From the resource standpoint, the high grade vein-type and unconformity-related deposits are relatively more important in the Athbasca basin region. In the Thelon basin region, an example of the vein-type deposits is the LGT (Lac Cinquante) prospect. The unconformity-related deposits are represented by the Boomerang Lake U-Au prospect, which occurs in the basal Thelon sandstone above graphitic metapelite in the basement, and by the Kiggavik (formerly Lone Gull) deposit in a fault zone in the basement where the Thelon sandstone is eroded. The Kiggavik deposit may have had precursor vein-type mineralization. (Abstract Truncated)

44655 (IAEA-TECDOC–500, pp. 429-454) **Kiggavik (Lone Gull): An unconformity related uranium deposit in the Thelon basin, northwest territories, Canada.** Fuchs, H.D. (Urangesellschaft m.b.H. und Co. K.G., Frankfurt am Main (Germany, F.R.)); Hilger, W. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Among several uranium prospects in the Baker Lake area, located at the northeastern rim of the Thelon Basin, the Kiggavik (Lone Gull) deposit is at an advanced exploration stage. Two ore zones, the Main and Centre Zones have been explored by drilling spaced 30mx15m and reserves of over 40 million lbs U3O8 with an average grade of 0,6% U3O8 are indicated. The Kiggavik mineralization is basement hosted in mica rich quartz-feldspathic metasediments of probably Aphebian age and in a late Hudsonian granite. The level of erosion reached in the area of the deposit below the Middle Proterozoic Thelon Sandstone, has removed traces of the Aphebian paleo-surface and parts of the deposit, leaving the closest outcrops of the unconformity approximately 2 km to the north. A post-ore diabase dyke has intruded the Main Zone with the effect that some ore was redistributed. Parallel, cigar-shaped ore lenses and the surrounding alteration halos are defined by sets of crosscutting structures. The strike of the lenses in the Main Zone is ENE and they plunge at 25 deg. in the same direction. In the Centre Zone, located on strike approximately 600 m ENE of the Main Zone, the mineralization occurs in meta-arkoses and schists. A barren orthoquartzite horizon controls the form and separates two ore lenses. Graphitic series are not known in the vicinity of the deposit but organic matter is found in all ore zones. Kiggavik is a monometallic deposit with pitchblende and coffinite as the main ore minerals. Common features with uranium deposits in the Athabasca basin such as a general relation to the unconformity, similar alteration, structural control, presence of diabase dykes and chronology of the deposit etc., emerged in the course of exploration. (Abstract Truncated)

44656 (IAEA-TECDOC–500, pp. 455-490) **Eagle Point uranium deposits, northern Saskatchewan, Canada.** Andrade, N. (Eldorado Resources Ltd, Saskatoon, Saskatchewan (Canada)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Eagle Point uranium deposits are located on the eastern edge of the Athabasca Basin, about twelve kilometres north-northeast of the Rabbit Lake mill complex in northern Saskatchewan. These deposits were discovered in 1980 during systematic drill testing of geophysical and uranium-in-till anomalies associated with the Collins Bay Fault, in the area northeast along strike from the Collins Bay B-Zone, D-Zone, and A-Zone uranium deposits. The Eagle Point deposits consist of a series of moderately steeply dipping tabular veins and lenses which are both concordant and discordant to, and wholly within, Aphebian metasedimentary rocks. The mineralization outlined to date occurs entirely within the hanging wall of the Collins Bay Fault. The deposits occur within the variably graphitic lowest unit of the Aphebian Wollaston Group, and within 1.5 metres to 365 metres of the underlying, possibly Archean granitoid basement. Mineralization is considered to be primarily structurally controlled. This conclusion is based on the discordant nature of the veins, the presence of microstructures within the veins, and the lack of any consistent association between mineralization and lithology. Mineralization consists of uraninite and pitchblende, and has been dated at 1400+-25 Ma, with younger generations recognized. Only minor amounts of some other metals are present. The alteration associated with the mineralization is moderately to strongly developed, and consists mainly of illitization. Zones of intense alteration extend less than one metre from mineralization. Hematite is spatially associated with much of the mineralization. The combined deposits are currently estimated to contain geological reserves of about 51,200 tonnes U. The origin of the deposits remains speculative at this time. (author). 22 refs, 12 figs, 2 tabs.

44657 (IAEA-TECDOC–500, pp. 491-518) **Albitite-type uranium mineralization in the Nonacho basin area, northwest territories, Canada.** Gatzweiler, R. (Uranerzbergbau G.m.b.H. und Co. K.G., Bonn (Germany, F.R.)); Pechmann, E. von; Loewer, R.; Strnad, G.; Fritsche, R. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

The Proterozoic Nonacho Basin extends along the 110 deg. W meridian between Lake Athabasca and the East Arm of Great Slave Lake, NWT, Canada. This basin overlies a sinistral shear zone developed in the Archean (+ 2.5 Ga) basement of the Keewatin Block at its transition to the 2.0-1.9 Ga-reactivated Taltson Magmatic Zone in the westernmost part of the Churchill Province. The age of this basin's Proterozoic supracrustals is constrained by the traversing Sparrow diabase dykes for which a minimum age of 1.7 Ga has been interpreted. At Mosquito Gulch, one of the five occurrences, a uranium mineralized zone with an E-W strike extent of more than 500 m and a width of 20 to 50 m was outlined by drilling to a depth of 200 m. The mineralized zone dips at an angle of 45 deg. to the south and plunges 10 to 20 degrees to the southeast. The host rocks are chloritic albitite microbreccias with epidote, sericite, quartz, and calcite as accessories. Uraninite occurs mainly within the chloritic matrix of the cataclasites along shear and fracture planes. The Mosquito Gulch mineralization is monometallic and geochemically characterized by very low Th and enhanced Ti, Zr, P, and Y values. From results of U/Pb isotope analyses a maximum age of primary

uranium mineralization of 2.2 Ga is interpreted. Grades and thicknesses of the Mosquito Gulch mineralization show little continuity. The overall grade of the mineralized zone is about 1 lb U_3O_8 per tonne. The metal content of the deposit is drastically reduced if the cut-off is raised. The economic significance of the albitite-type occurrences in the Nonacho area specifically and of albitite-type deposits in other parts of the Western World at uranium prices below US$ 30 per lb U_3O_8 is rather limited. The irregular vein-type nature of these deposits combined with low to medium average grades cause high average production costs. (Abstract Truncated)

44658 (IAEA-TECDOC–500, pp. 521-522) **Swanson uranium deposit, Pittsylvania County, Virginia, USA: Stratigraphy, petrology and ore mineralogy.** Frishman, D. (Geological Survey, Denver, CO (USA)); Halladay, C.R.; Hauck, S.A.; Kendall, E.W. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

Abstract only.

44659 (IAEA-TECDOC–500, pp. 519) **Swanson uranium deposit, Virginia: A structurally controlled, U-P albitite deposit.** Halladay, C.R. (Marline Uranium Corp., Danville, VA (USA)). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

In 1977, Marline initiated ground and airborne radiometric reconnaissance surveys in serveral states immediately east of the Appalachian Mountains. Exploration focused on contacts between sedimentary rocks of Mesozoic basins and older basement rocks, and lead to the discovery of several anomalies along the western border fault of the Danville Triassic basin in southern Virginia. Detailed drilling at one anomaly delineated two large, nearly contiguous, uranium orebodies in metamorphic rock: Coles Hill South (the Swanson deposit) and Coles Hill North. Uranium mineralization occurs primarily within cataclastic zones in augen gneisses and amphibolites. Fine-grained coffinite/uraninite, associated with fluorapatite and chlorite, occurs as disseminations and in narrow healed fractures. Pervasive sodium metasomatism has resulted in albitization, quartz dissolution, and local development of sodium amphiboles. There is evidence of multiple stages of cataclasis, albitization, chloritization and hematitization. Geological reserves for both deposits were initially estimated on the basis of vertical sections. The Swanson deposit was determined to contain 49 million lbs. U_3O_8 at an average grade of 0.113%, above a cutoff of 0.05%. The North deposit has similar total reserves but a lower average grade. Swanson deposit reserves were subsequently verified by use of polygonal and kriged block model methods. Minerable reserves within a proposed 110-acre, 880-foot deep pit were calculated to be 16.2 million tons of ore containing 34 million lbs. U_3O_8. The ore is amenable to an alkaline leach, with 85% recovery. Financial anlayses have confirmed the economic feasibility of developing the Swanson deposit. Other anomalies along the border fault which have not yet been thoroughly evaluated may represent additional significant uranium reserves. (author).

44660 (IAEA-TECDOC–500, pp. 523) **Detailed mineralogy and alteration of the Swanson uranium deposit, southern Virginia, USA.** Hauck, S.A. (Minnesota Univ., Duluth, MI (USA). Natural Resource Research Inst.); Kendall, E.W.; Halladay, C.R. International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS

The Swanson Uranium Deposit is hosted in augen gneisses and is strongly affected by mylonitic and cataclastic events. Overall, mineralization appears to be subparallel to the intersection of mylonitic foliation and an en echelon set of planar cataclastic zones. The deposit was most likely formed as a result of the regional tectonic events which developed this zone of mylonitisation adjacent to the Triassic graben basin. The principal ore assemblage is a very fine grained mixture of coffinite - chlorite - fluroapatite and associated anatase and calcite. Pitchblende is present in only minor amounts and monazite (U, Th poor) is a trace accessory. An estimated 10-15% of the total ore-stage uranium is found in the aratite. The uranium content of pre-ore anatite averages 0.02% UO_2, whereas ore stage apatite averages 0.5% UO_2. Some euhedral, optically clear apatite contains over 3.5% UO_2. Petrologic studies and whole rock analyses show the most significant alteration to be a multistage Na metasomatism process. This is characterized by quartz removal and a minor bulk density decrease and porosity increase. Mineralogically this is evidenced by alteration of oligoclase and potassium feldspart to albite, development of euhedral albite overgrowths on feldspar and quartz, and albite inclusions in zoned apatites. Further evidence of Na metasomatism is the development of the sodium amphibole riebeckite from preexisting amphiholes and chlorite. Riebeckite also develops on voids and along open fractures. Some dark blue faults (ultra cataclasites) further suggest the interrelationship of Na alteration and the most intense deformational events. Aside from the U and phosphorous, the deposit is notable for its lack of geochemical enrichment in other metals commonly associated with many U deposits. (author).

0504 Feed Processing

Refer also to citation(s) 45629

44661 (INIS-BR–1608) **Application of isotopic dilution techniques by alpha and mass spechometry for determining uranium and evaluated its distribution in geological materials.** Shihomatsu, H.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1987. 121p. (In Portuguese). Order Number DE89636197/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Determination of uranium in the concentration range of 2 to 4000 ppm in nuclear raw materials by mass spectrometric (MSID) and alpha spectrometric isotope dilution techniques (ASID), using the isotope tracer enriched in ^{233}U, is presented. An investigation on the nature of the thermoionic emission in various types of filament arrangements like, single plane rhenium, single boat and double, are carried out for the isotope analysis by mass spectrometry. In the preparation of the sources for alpha spectrometry by electrodeposition the experimental parameters such as: current density, pH of the mixed solution containing sample and electrolyte, concentration of the electrolyte solution, time of deposition and distance between electrodes are optimised. The accuracy of the technique is discussed based on the determination of uranium in the same samples by other research workers employing various analytical techniques including mass spectrometric and alpha spectrometric isotope dilution techniques (MSID and ASID). (author).

0505 Uranium Enrichment

Refer also to citation(s) 44671

44662 (K/QT–297) **Reactions of aluminum with uranium fluorides and oxyfluorides.** Leitnaker, J.M.; Nichols, R.W.; Lankford, B.S. Oak Ridge Gaseous Diffusion Plant, TN (USA). Jun 1989. 21p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OT21400. Order Number DE89016532/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Every 30 to 40 million or so operating hours, a destructive reaction is observed in one of the ~4000 large compressors that move UF_6 through the gaseous diffusion plants. Despite its infrequency, the reaction can be costly in terms of equipment and time. Laboratory experiments reveal that the presence of moderate pressures of UF_6 actually cools heated aluminum, although thermodynamic calculations indicate the potential for a 3000–4000°C temperature rise. Within a narrow and rather low pressure range (<100 torr; 1 torr =

133.322 Pa), however, the aluminum is seen to react with sufficient heat release to soften an alumina boat. Three things must occur in order for aluminum to react vigorously with either UF_6 or UO_2F_2: (1) An initiating source of heat must be provided. In the compressors this source can be friction, permitted by disruption of the balance of the large rotating part or by creep of the aluminum during a high-temperature treatment. In the absence of this heat source, compressors have operated for 40 years in UF_6 without significant reaction. (2) The film protecting the aluminum must be breached. Melting (of UF_5 at 620 K or aluminum at 930 K) is a way to do this in the laboratory. In contrast, holding aluminum samples in UF_6 at 870 K for several hours produces only very moderate reaction. Rubbing in the cascade can undoubtedly breach the protective film. (3) Reaction products must not be allowed to build up and smother the reaction. While uranium products tend to dissolve or dissipate in molten aluminum, AlF_3 shows a remarkable tendency to surround and thus protect even molten aluminum. Therefore, the initial temperature rise must be rapid and sufficient to move reactants into a temperature region in which products are removed from the reaction site.

0507 Fuels Production and Properties

Refer also to citation(s) 44670, 44833, 45045, 45060, 46510, 46511

44663 (CTA-IEAv-NT–001/89) **Implementation of plot options for the NJOY module DTFR.** Caldeira, A.D.; Ono, S. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. Feb 1989. 21p. Order Number DE89636513/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The modifications performed in the DTFR module of NJOY to plot multigroup and pointwise nuclear data and transfer matrices, utilizing the sofware package UNIPLOT in the CDC CYBER 170/750 system, are presented. (author).

44664 (LA-UR–89-2178) **Remote-controlled NDA [nondestructive assay] systems for process areas in a MOX [mixed oxide] facility.** Miller, M.C.; Menlove, H.O.; Augustson, R.H.; Ohtani, T.; Seya, M.; Takahashi, S.; Abedin-Zadeh, R. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890736–58: 30. annual meeting of the Institute of Nuclear Materials Management, 9-12 Jul 1989). Order Number DE89015274/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Nondestructive assay (NDA) systems have been designed and installed in the process area of an automated mixed-oxide (MOX) fuel fabrication facility. These instruments employ neutron coincidence counting methods to measure the spontaneous-fission rate of plutonium in the powders, pellets, and fuel pins in the process area. The spontaneous fission rate and the plutonium isotopic ratios determine the mass of plutonium in the sample. Measurements can be either attended or unattended. The fuel-pin assay system (FPAS) resides above the robotic conveyor system and measures the plutonium content in fuel-pin trays containing up to 24 pins (~1 kg of plutonium). The material accountancy glove-box (MAGB) counters consist of two slab detectors mounted on the sides of the glove box to measure samples of powder or pellets as they are brought to the load cell. Samples measured by the MAGB counters may contain up to 18 kg of MOX. This paper describes the design and performance of four systems: the fuel-pin assay system and three separate MAGB systems. The paper also discusses the role of Monte Carlo transport techniques in the detector design and subsequent instrument calibration. 5 refs., 11 figs., 6 tabs.

44665 (Y/DW–890) **Characterization of electron-beam weld processes in uranium by acoustic emission monitoring.** Whittaker, J.W.; Murphy, J.L. Oak Ridge Y-12 Plant, TN (USA). 19 Aug 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. Order Number DE89016044/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Work was begun to characterize electron-beam (EB) welding of uranium by use of acoustic emission (AE) monitoring at the Oak Ridge Y-12 Plant. One specific objective was to determine if a correlation existed between weld penetration and an AE parameter(s). AE monitoring techniques were developed which allowed detection and recording of AE information during welding. Initial results from bead-on-plate welds of uranium imply that the AE signal varies during different processes: weld initiation, process stabilization, steady-state weld formation, weld cessation, and material cooldown. A correlation was developed between the AE "average signal level" (ASL) parameter and weld penetration which implies that penetration can be predicted from a given measured ASL level. 1 ref., 7 figs., 1 tab.

0508 Spent Fuels Reprocessing

Refer also to citation(s) 44753, 44780, 44820, 45159, 45589

44666 (NUREG/CP–0098-Vol.1, pp. 100-114) **Concepts and operating results of minimizing radioactive emissions for the Wackersdorf reprocessing plant.** Furrer, J. (Kernforschungszentrum Karlsruhe GmbH, Karlsruhe (Germany, F.R.)); Weinlaender, W. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

In a time of growing concern over environmental impacts from any industrial plant, the ideal goal of zero release has to be approached. This applies to the industrial reprocessing plant in Wackersdorf (WAW), too. Regarding gaseous emissions, remarkable efforts have been made in Germany to improve the off-gas cleaning systems. Significant results and operation experience from KfK, WAK and PAMELA are presented. The design of the off-gas trains for WAW is based on these results. It fulfils operational needs as well as the requirements imposed by the German licensing authorities to minimize as far as possible any impacts from emissions. Off-gas systems in reprocessing plants have to treat dry and humid gas streams and to separate aerosols and gaseous materials. A minimization of emissions will be achieved by improving the cleaning units of the off-gas lines and by decreasing the total amount of off-gas or of special constituents. Both measurements are presented, and the decontamination factors achieved are described. In this context, details are given of the behavior of some nuclides such as ruthenium and iodine. Finally, the emissions expected of WAW are indicated.

44667 (NUREG/CP–0098-Vol.1, pp. 138-153) **Modelling of a selective absorption process for rare gas removal from reprocessing off-gas.** Roemer, J.; Henrich, E. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

A mathematical model for a selective absorption process for rare gas recovery from the dissolver off-gas will be presented. The process is a conventional gas absorption-desorption procedure using circulating $CC1_2F_2$ solvent at cryogenic temperatures. A high product purity is achieved with an additional intermediate stripping step for the removal of coabsorbed carrier gases. The mathematical model is based on the stage theory. The absorber and the final desorber can be described by simple equations, because the operating conditions are constant over the packed length. For the intermediate stripper the whole system of material and energy balance equations has to be solved for each stage. An iterative procedure has been developed, which allows the determination of flow and concentration profiles for each gas component. A selfconsistent temperature profile terminates the iteration. The model requires experimental distribution data of the various gas components, operating conditions and design parameters such as the number of stages in the packed zones, which must be determined experimentally. Optimum operation conditions have been predicted by the model and verified in the pilot plant.

44668 (NUREG/CP–0098-Vol.1, pp. 154-178) **Development of a cryogenic absorption process for rare gas removal from reprocessing off-gas.** Henrich, E. (Kernforschungszentrum Karlsruhe (Germany, F.R.)); Weirich, F. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

A selective absorption process for xenon, krypton and $14CO_2$ removal from reprocessing dissolver off-gas has been developed. Process and equipment design has been investigated since 4 years on the cold engineering scale at 25 m^3/h gas troughput. The rare gases are absorbed in two successive absorption columns in CCl_2F_2 solvent. The first column removes the Xe plus $14CO_2$ at about -125°C, the second column removes the Kr at about -150°C. Freezing gas components are removed in prepurification steps at temperatures below 0°C: A scrubber with circulating 4-10 M HNO_3 plus H_2O_2 removes water vapor and NO_x to less than 1000 ppm; the small remainder is removed to the trace level with a H-mordenite molecular sieve adsorber. Essential technical and safety characteristics are: (1) the system operates at slightly subambient pressure (2) the Kr residence time is less than half an hour (3) the process is insensitive to impurities and even compatible with ozone; no preremoval of O_2 is needed.

44669 **Remote CCTV system.** Prell, G.A.; Wiesener, R.W. *Transactions of the American Nuclear Society (USA),* 57: 338-340 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

A closed-circuit television (CCTV) system has been designed for remote viewing of operations in large nuclear process facilities. The system consists of portable monitoring and control consoles (PMCCs), which can be located at up to 40 different plug-in stations and can monitor and control selected cameras from up to 50 in-cell locations. In-cell crane-mounted cameras utilize duplex laser communication links for video and control signal transmission, which replaced complex cable handling systems. The basis system is illustrated. Radiation-hardened pan-and-tilt mounted cameras are remotely replaceable. All camera assemblies, except the crane-mounted units, include microphones for sound monitoring, and the station audio signal can be directed to any PMCC plug-in station.

0509 Transport and Storage

Refer also to citation(s) 44833, 46044

44670 (WHC-SA–0352) **Radiolysis and pressurization.** Sudmann, R.H. Westinghouse Hanford Co., Richland, WA (USA). Jun 1988. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-880680–2: Prevention of significant nuclear events conference, 6-9 Jun 1988). Order Number DE89016057/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Radiolysis of water and the concomitant pressurization of the vessels is well recognized in the case of radium needles. The process is the result of the radiolysis of water associated with the radium salts. Mme. Curie, in 1911, anticipated the problems and took pains to eliminate the water of crystallization of the radium chloride to be packed into needles (Morgan, 1961). Once radium salts are dry the only pressure buildup in a sealed system is an eighth of an atmosphere per year from the generation of helium. The problem has once again been recognized with the handling of high specific activity solutions of plutonium and other alpha emitters. In the past few years a number of contamination spreads have occurred in laboratories and production facilities. Investigations of these spreads suggested the root cause as pressurization caused by the radiolysis of water. It was identified in solutions of plutonium, uranium-233, and in one case a high-energy beta emitter. This paper reports on the problem which we identified and the program developed to control it. 11 refs., 1 tab.

0510 Marketing, Economics, and By-products

Refer also to citation(s) 44626, 44657

44671 (AECL–9255) **Advances in uranium enrichment processes. A challenge to innovation.** Rae, H.K.; Melvin, J.G.; Slater, J.B. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. May 1986. 26p. (CONF-8606428–: Canadian Nuclear Association international nuclear conference, 8-11 Jun 1986). Order Number DE89635638/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Advances in gas centrifuges and development of the atomic vapour laser isotope separation process promise substantial reductions in the cost of enriched uranium. The resulting reduction in LWR fuel costs could seriously erode the economic advantage of CANDU, and in combination with LWR design improvements, shortened construction times and increased operational reliability could allow the LWR to overtake CANDU. CANDU's traditional advantages of neutron economy and high reliability may no longer be sufficient - this is the challenge. The responses include: combining neutron economy and dollar economy by optimizing CANDU for slightly enriched uranium fuel; developing cost-reducing improvements in design, manufacture and construction; and reducing the cost of heavy water. Technology is a renewable resource which must be continually applied to a product for it to remain competitive in the decades to come. Such innovation is a prerequisite to Canada increasing her share of the international market for nuclear power stations. The higher burn-up achievable with enriched fuel in CANDU can reduce the fuel cycle costs by 20 to 40 percent for a likely range of costs for yellowcake and separative work. Alternatively, some of the benefits of a higher fissile content can take the form of a cheaper reactor core containing fewer fuel channels and less heavy water, and needing only a single fuelling machine. An opportunity that is linked to this need to introduce an enriched uranium fuel cycle into CANDU is to build an enrichment business in Canada. This could offer greater value added to our uranium exports, security of supply for enriched CANDUs, technological growth in Canada and new employment opportunities. AECL has a study in progress to define this opportunity.

44672 (IAEA-TECDOC–500, pp. 13-28) **Comparative study of the US and Canadian uranium industries.** Chung, T. (USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels). International Atomic Energy Agency, Vienna (Austria). Mar 1989. (CONF-8709462–: Technical committee meeting on uranium resources and geology of North America, 1-3 Sep 1987). In *Uranium resources and geology of North America. Proceedings of a technical committee meeting held in Saskatoon, Canada, 1-3 September 1987.* Order Number DE89636254/JAW. Available from NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS.

This paper describes statistical data on the uranium industries in the United States and Canada, as well as a quantitative analysis of the costs relevant to the industry in each country. Comparative data on the U.S. and Canadian uranium industries are presented in the following three subject areas: (1) the uranium raw materials situation in each country, focusing on uranium deposits and ore reserves, uranium mining operations, uranium concentrate production rate, the status of uranium mills and other production facilities, industry employment, and trends in mining and milling practices; (2) uranium prices, production capabilities, imports and exports of uranium, and industry ownership and control; and (3) comparative data on uranium production costs and costs due to institutional differences such as the effects of the U.S. and Canadian corporate tax structures. The major uranium-producing States and provinces: New Mexico, Wyoming, Texas, Saskatchewan, and Ontario are listed separately in most of the tables in this paper. The remainder are aggregated into "others" for both the United States and Canada. (author). 4 figs, 4 tabs.

0520 Waste Management

Refer also to citation(s) 44666, 44667, 44668, 44669, 44793, 44794, 44795, 44796, 44797, 44798, 44799, 44800, 44801, 44802, 44803, 44804, 44805, 45085, 45086, 45087, 45089, 45090, 45091,

45092, 45093, 45094, 45095, 45096, 45097, 45098, 45099, 45100, 45101, 45102, 45150, 45159, 45201, 45729, 45771, 46044, 46114, 46116, 46119, 46120, 46121, 46143, 46146, 46181, 46721

44673 (AECL–8403) **Removal of iodomethane from air using a pilot-scale corona discharge scrubber.** Dickson, L.W.; Toft-Hall, A.; Torgerson, D.F. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Dec 1985. 19p. (CONF-8510301–: 35. Canadian Chemical Engineering conference: leading edges of technology, 6-9 Oct 1985). Order Number DE89635600/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report presents the results of a study of the removal of iodomethane from air using a pilot-scale corona discharge scrubber. The removal was measured in the following parameter ranges: bulk air flow, 30 to 350 m^3/h; initial CH_3I concentration, 6 to 230 $\mu mol/m^3$; and discharge current, 0 to 75 mA DC (negative polarity). Approximately five to ten moles of iodomethane are removed per mole of electrons added to the air stream at a discharge voltage of $\sim$ 10 kV. This removal efficiency suggests that both ion-molecule and radical-molecule reactions may be important in the removal of iodomethane from air in a corona discharge. The results of this pilot-scale demonstration indicate that a corona discharge scrubber would be suitable for removing iodine species from air as part of the emergency filtered-air discharge system of a nuclear reactor. The application of this technology to the control of nitrogen oxide, sulfur dioxide and hydrogen sulfide emissions is being investigated. 15 refs.

44674 (AERE-R–13358) **Assessment of a prototype VSP filter in a pilot plant.** Kavanagh, P.; Cumming, I.W. UKAEA Harwell Lab. (UK). Jun 1988. 29p. (DOE-RW–89.034). Available from British Library, Lending Division, Boston Spa, Wetherby, West Yorks.

A novel design of cross-flow filter was supplied for testing at Harwell. This filter consisted of six cylinder perspex tubes each of which contained a coiled stainless steel wire filter element. Filtration took place from outside to inside on the filter element. The filtration gap could be adjusted by extension of the spring. Tests were carried out filtering three different liquids, mains water, ferric hydroxide floc and Harwell Low Level Waste. The filter was operated after precoating with filter aid. An optimum filter-aid concentration of 250ppm was established. Filter tests using tap water gave a steady state flux of 20m/d at 2 bar. Filtering ferric hydroxide floc at pH 9.5 gave a permeate containing < 0.5mg/l.Fe at a steady state flux of 8m/d. Processing Harwell LLW gave an α removal to less than "approx." 2.5 x 10^{-3}Bg/ml and a flux which declined from 20m/d to 2.5m/d over 40 minutes operation. The membrane could be effectively cleaned by extending the springs and backwashing with water at 4bar(g). (author).

44675 Nonparametric approach for localized stochastic model of rock joint systems. Young, D.S. (Michigan Technological Univ., Houghton (USA)); Hoerger, S.F. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; 15-17 Sep 1987.

Geostatistics was extended to regionalize random unit vectors and applied to develop a localized stochastic model of joint systems in geological formations. The characteristic parameters of rock joints regionalized in the model are the vectorial variable of orientation and the scalar variables of joint spacing, maximum length, average length, and surface roughness. Indicator kriging (IK) was incorporated with the local block model development to estimate the probability distributions of those rock joint parameters. The pole vector of a joint plane projected on the upper reference hemisphere was regionalized directly and its spatial variability was measured by the difference vector. The probability distribution of pole vectors was plotted on the tangent plane and a two-dimensional cutoff system was developed to define its indicator variables. Actual IK for pole vectors was carried out by Mononodal IK to economize the IK process and toe overcome a potential problem of kriging systems due to a large number of cutoff points compared to the number of available data for kriging. The application of IK to other scalar parameters is a straightforward process estimating their local probability distributions within each block. Consequently, a complete set of joint parameters was modeled and their probability distributions were estimated for each local block. The IK procedure used in this joint modeling was verified through a case study made on an open pit mine, were rock joint systems were surveyed completely on the pit walls. An IK estimate of the local statistical distribution based on only one quarter of the survey data was compared with the actual sample histogram of survey data within the same block.

44676 Evaluating the effect of sampling and spatial correlation on ground-water travel time uncertainty coupling geostatistical, stochastic, and first order, second moment methods. Andrews, R.W. (INTERA Technologies, Inc., Austin, TX (USA)); LaVenue, A.M.; McNeish, J.A. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; 15-17 Sep 1987.

Ground-water travel time predictions at potential high-level waste repositories are subject to a degree of uncertainty due to the scale of averaging incorporated in conceptual models of the ground-water flow regime as well as the lack of data on the spatial variability of the hydrogeologic parameters. The present study describes the effect of limited observations of a spatially correlated permeability field on the predicted ground-water travel time uncertainty. Varying permeability correlation lengths have been used to investigate the importance of this geostatistical property on the tails of the travel time distribution. This study uses both geostatistical and differential analysis techniques. Following the generation of a spatially correlated permeability field which is considered reality, semivariogram analyses are performed upon small random subsets of the generated field to determine the geostatistical properties of the field represented by the observations. Kriging is then employed to generate a kriged permeability field and the corresponding standard deviation of the estimated field conditioned by the limited observations. Using both the real and kriged fields, the ground-water flow regime is simulated and ground-water travel paths and travel times are determined for various starting points. These results are used to define the ground-water travel time uncertainty due to path variability. The variance of the ground-water travel time along particular paths due to the variance of the permeability field estimated using kriging is then calculated using the first order, second moment method. The uncertainties in predicted travel time due to path and parameter uncertainties are then combined into a single distribution.

44677 Use of Bayesian analysis for incorporating subjective information. Eslinger, P.W. (BCS Richland, Inc., WA (USA)); Sagar, B. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; 15-17 Sep 1987.

Large uncertainties are inherent in characterizing geologic media and in defining the future conditions under which geologic repositories must perform. Therefore, incorporating subjective information is an important aspect of quantitative assessment of repository performance. One method of incorporating subjective information in a quantitative analysis is demonstrated in this paper. Lacking objective data from laboratory and field tests, subject information is coded to form prior distributions of the unknown parameters of the distribution of a variable. However, this technique presents some complications, as will be discussed further. As objective data are obtained, Bayes' theorem is used to derive estimates of the parameters. The use of conjugate prior distributions for performing this analysis is also discussed. Two applications for the Basalt Waste Isolation Project (BWIP) are presented. The first pertains to subjective information obtained through probability encoding of the two parameters of the distribution of effective porosity at the macro scale. Only one measured value of effective porosity is currently available. Estimates for the two parameters are obtained by incorporating the single data point. The example is extended further to illustrate the effects that additional data may have on estimating the posterior distributions.

The second application is for hydraulic transmissivity in a multivariate setting. No multivariate data are currently available.

44678 (CONF-881054–Vol.1, pp. 55-63) **Use of geographic information system (GIS) technology for the siting of low-level and high-level radioactive wastes.** Dressen, A.L. (Roy F. Weston, Inc. (USA)); Harvey, B.H. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

A GIS can be a major tool to aid decision-makers in carrying out a process to select sites for waste management facilities. The computerization available through a GIS allows for rapid processing of data to screen from a region of interest to candidate areas to potential sites. It provides flexibility in the way the results are displayed to enhance understanding by various audiences. Perhaps most important, it allows rapid and efficient sensitivity analyses of the criteria and weighting factors that are considered in the siting decision.

44679 (CONF-881054–Vol.1, pp. 167-177) **Selective separation process of radionuclides in liquid wastes.** Suzuki, K. (JGC Corp., Tokyo (Japan)); Watanabe, M.; Shibuya, M.; Kuribayashi, H. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Radioactive liquid wastes at nuclear power plants or other nuclear facilities generally contain low-level radioactivities with a large amount of non-radioactive materials. The liquid wastes have been treated by the method of evaporation or cement solidification. However, in the low-level waste management, one of most important targets is the volume reduction by a simple and an economical process. JGC has investigated the radioactive and chemical behavior in actual liquid wastes, and developed an unique treatment process. Radionuclide separation process called RASEP, selectively removes Co, Ni, Mn, Zn, Sr and Cs nuclides which are main radioactive sources in the wastes. By this separation process, the decontaminated liquid wastes are able to be safely discharged or disposed of into the environment. A process system with a simple and economical operation is proposed.

44680 (CONF-881054–Vol.1, pp. 179-189) **Selective extraction of cobalt 60 and radium on CSA's SIM™ system.** Denton, M.S.; Higgins, I.R. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

CSA, has developed and promoted a new ground/well water treatment media and support system for hydrogen sulfide, iron, and manganese called The SIM System. This media was also found to have a selective affinity for arsenic, selenium, antimony, bismuth and lead. All heavy metals have not been checked, but of special rad-waste interest is Co-60 and Ra-226. Barium has been used as a stand-in for Ra in the lab, but both Co and Ba have exhibited very high affinities from Oak Ridge waters. A very attractive feature is that the adsorbed metals may be eluted with a minimum of acid, unlike ion exchangers that regenerate with difficulty or zeolites which dissolve in acids. This opens up the new dimension of extraction/concentration of these contaminants. Ordinary water softening ion exchange resin is excellent for extraction of Ra from drinking water, but, as mentioned, regenerates with great difficulty. The SIM media may be used for pre-treatment with the acid regenerant reloaded on ordinary resin for a very high concentration of Ra, or Co, for final disposal. The very stable SIM media may also be disposed of directly. Strontium (Sr-90) affinity isn't as great as for barium, but is greater than calcium. The separation factor of SIM for Sr/Ca may well be better than the value of two (2) observed for ordinary cation resin. Further studies are being made to demonstrate the full potential of this selective media for certain rad-wastes.

44681 (CONF-881054–Vol.1, pp. 191-202) **Feasibility study of alternative treatment methods for MVST supernatant at ORNL.** Goldsmith, W.A.; Teichert, W.P.; Allen, D.F.; Ragan, C.C.; Monk, T.H. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

The Melton Valley Storage Tanks (MVST) at Oak Ridge National Laboratory (ORNL) currently contain greater than 370,000 gal of liquid radioactive waste concentrate. This volume is approaching 100% of the available storage capacity. These liquids may be characterized as concentrated alkaline-nitrate solutions contaminated with mCi/L concentrations of ^{137}Cs and lower levels of other radionuclides. Pretreatment of the liquid by clarification and filtration yields a supernatant requiring a decontamination factor (DF) of 300 for ^{137}Cs and 150 for ^{90}Sr for subsequent on-site disposal as a concrete monolith. Alternatives investigated for achieving these DFs may be broadly grouped as ion exchange, precipitation, and evaporation. Three specific treatment systems within each broad group were analyzed on the basis of achievable volume reduction, decontamination performance, implementability, and protection of workers and the environment. Nonregenerable ion exchange was selected on the basis of these criteria. This paper presents the rationale for this selection.

44682 (CONF-881054–Vol.1, pp. 205-216) **Egyptian waste management policy.** Higgy, H.R. (Nuclear Power Plants Authority, Cairo (Egypt)). Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

The Egyptian Nuclear Power Program for electricity production up to the year 2000 is expected to include two nuclear power stations of total installed capacity of 1500 MW(e). The first one is planned to be of the Pressurized Water Reactor type (PWR) with capacity of 900 MW(e), while the second will be of the Pressurized Heavy Water Reactor type (PHWR) with capacity of 600 MW(e). The Egyptian policy of radioactive waste management is based on the storage of spent fuel at reactor site (AR) for 20 years, followed by an interim storage with sufficient capacity to allow for enough time to develop final disposal site. Low- and intermediate-radioactive waste generated from nuclear power plants operation will be treated and stored at reactor site for a suitable time before disposal in a final repository. Low- and intermediate-level wastes generated from research and domestic activities are treated and conditioned in Waste Management Facility being constructed in the Atomic Energy Authority at Inchas site. In this facility, man-power development programs will be carried out. Egypt is following the international development of spent fuel and radioactive waste management methods and is planning to cooperate with various countries to promote the development of Egyptian policy.

44683 (CONF-881054–Vol.1, pp. 229-239) **Solid low level waste disposal.** Larkins, W.S. (British Nuclear Fuels Ltd., Sellafield). Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Solid low level waste from nuclear industry and other sources within the UK has been disposed of at the BNFL Drigg site in Cumbria for nearly thirty years. A strategy has been developed, and is being implemented, to continue the use of Drigg based upon upgraded facilities for long term monitored, retrievable storage leading to disposal in concrete vaults. The approach takes account of the need to ensure adequate operational and post-closure safety and to secure and retain public acceptance.

44684 (CONF-881054–Vol.1, pp. 241-252) **Encapsulation of solid intermediate level waste.** Howarth, G.G. (British Nuclear Fuels plc). Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

British Nuclear Fuels plc (BNFL) operates irradiated fuel reprocessing facilities at its Sellafield Site in Cumbria, England. Reprocessing operations give rise to a variety of solid intermediate level radioactive wastes. This paper discusses the development, design, construction, and commissioning of BNFL's first solid waste encapsulation plant which is programmed to come onstream in 1990.

44685 (CONF-881054–Vol.1, pp. 253-263) **Treatment, conditioning and packaging of low and medium level radioactive wastes at the Karlsruhe Nuclear Research Center.** Pfeifer, W. (Karlsruhe Nuclear Research Center (West Germany)). Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

At the Karlsruhe Nuclear Research Center (KfK), all radioactive residues and radioactive primary waste are delivered to the Central Decontamination Operations Department (HDB). The report describes the main processes applied in the treatment and conditioning of waste, such as evaporation plants, solidification facilities and scrapping facilities, decontamination equipment, incineration plants, interim stores. The Federal Government of the Federal Republic of Germany, which is responsible for construction and operation of the repository, published preliminary waste acceptance requirements in November 1986. The application of these requirements to the conditioning plants and the necessary quality control of the waste packages produced is reported.

44686 (CONF-881054–Vol.1, pp. 267-278) **Implications of RCRA regulation for the disposal of transuranic and high-level waste.** Sigmon, C.F.; Sharples, F.E.; Smith, E.D. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

In May of 1987 the Department of Energy (DOE) published a rule interpreting the definition of byproduct under the Atomic Energy Act. This byproduct rule clarified the role of the Resource Conservation and Recovery Act (RCTA) in the regulation of DOE's radioactive waste management activities. According to the rule, only the radioactive portion of DOE's mixed radioactive and hazardous waste (mixed waste), including mixed transuranic (TRU) and high-level waste (HLW), is exempt from RCRA under the byproduct exemption. The portion of a waste that is hazardous as defined by RCRA is subject to full regulation under RCRA. Because the radioactive and hazardous portions of many, if not most, DOE wastes are likely to be inseparable, the rule in effect makes most mixed wastes subject to dual regulation. The potential application of RCRA to facilities such as the Waste Isolation Pilot Plant (WIPP) and the HLW repository creates unique challenges for both the DOE and regulatory authorities. Strategies must be developed to assure compliance with RCRA without either causing excessive administrative burdens or abandoning the goal of minimizing radiation exposure. This paper will explore some of the potential regulatory options for and recent trends in the regulation of TRU and HLW under RCRA.

44687 (CONF-881054–Vol.1, pp. 279-285) **Development of type B container for transportation of contact-handled transuranic boxed waste.** Mendiratta, O.P. (Westinghouse Electric Corp., Carlsbad, NM (USA)). Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Current programs directions are being evolved and implemented to transport drums of contact-handled transuranic (CH-TRU) waste generated at defense-related sites. The TRUPACT-II design will handle boxed waste of limited dimensions only, due to size constraints. This paper analyzes the development and evaluation process for a type B container to transport waste currently stored in boxes. The available options discussed include repackaging, use of existing containers that envelop box dimensions, and even new container designs. An Interface Working Group (IWG) comprised of user sites and Sandia National Laboratories has been formed to evaluate container options and the economics of repackaging waste into smaller boxes or drums for transport in a TRUPACT-II. The IWG reviewed Department of Energy (DOE), Department of Transportation (DOT), and Nuclear Regulatory Commission (NRC) listings for certified packagings and other documents and developed a concise list of options. The possibility of moving all boxes to a central location, as well as use of a single facility for the size reduction/repackaging process, is also being evaluated.

44688 (CONF-881054–Vol.1, pp. 287-293) **Survey of DOE NDA practices for CH-TRU waste certification - illustrated with a greater than 10,000 drum NDA data base.** Schultz, F.J.; Caldwell, J.T.; Smith, J.R. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Nondestructive assay (NDA) techniques now in widespread use throughout the Department of Energy (DOE) sites which provide the required Waste Isolation Pilot Plant (WIPP) Waste Acceptance Criteria (WAC) certification include: Segmented Gamma Scanning (SGS), Passive Neutron Coincidence Counting (PNCC), and Differential-Dieway-based Passive-Active Neutron (PAN). The general practice is to provide multiple NDA measurements at various stages of waste packaging and certification; thereby affording numerous examples of NDA technique assay result comparisons. The authors have compiled a data base of more than 10,000 contact-handled transuranic waste isotope inventories from seven DOE sites which have utilized such multiple NDA measurements within the past few years. This data base is discussed.

44689 (CONF-881054–Vol.1, pp. 295-303) **Overview of the waste handling and packaging plant, a major processing facility for remote-handled transuranic waste.** Turner, D.W.; Stewart, R.C.; du Mont, S.P. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

The Waste Handling and Packaging Plant (WHPP) is a FY 1991 line item project proposed for construction at the Oak Ridge National Laboratory (ORNL). The purpose of the facility is to receive, package, certify and ship remote-handled (RH) and special case (SC) transuranic (TRU) waste to the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico. The scope of the facility includes the mobilization of liquids and sludges from the Melton Valley Storage Tanks, transport of these liquids and sludges to the WHPP, solidification to a certifiable waste form, and final packaging and shipment to WIPP. Various solid hot cell wastes will be received at the WHPP from storage at ORNL and from other Department of Energy (DOE) sites. The solid wastes will be removed from the storage or shipping container, examined, processed as required, certified and packaged for shipment to WIPP. All packages coming from the processing cell will be in 55 gallon drums, and the facility will have the capability to load these directly into a shielded drum shipping cask, or to load these into the RH TRU canister for remote welding and shipment to WIPP using the RH TRU canister cask.

44690 (CONF-881054–Vol.1, pp. 305-316) **Supercompaction and repackaging facility.** Barthel, J.M. (Rockwell International Corp., Golden, CO (USA)); Carlsen, A.L. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

The Rocky Flats Plant (RFP) Supercompaction and Repackaging Facility (SARF) project is being designed to replace the present labor intensive repackaging operation for transuranic (TRU) waste. Following two years of TRU waste processing technology evaluation including comprehensive domestic and international supercompaction operational review, a conceptual design was completed and $1.9M in funding was received in 1987. The supercompactor and support equipment contract has been awarded. Design of the containment glovebox and installation design has commenced and an operational target date of June 1, 1990, has been established. In order to process mixed waste, a hazardous waste treatment operating permit must be issued by the Colorado Department of Health and is expected to be included with the RFP-TRU Mixed Waste Part B operating permit scheduled for issue in early 1990. The semi-automated, glovebox-contained SARF is being designed to process 63,500 cubic feet of mixed TRU waste annually for disposal at the Waste Isolation Pilot Plant (WIPP). Preliminary evaluations indicate an average 5 to 1 volume reduction, 2 to 1 increased processing rate, and 50% reduction in manpower will be achieved. In addition to the significant annual cost savings in labor, material, shipping, and disposal costs, SARF over the projected 15 year life will also

improve operating safety, reduce personnel exposure, and improve the quality of the waste product.

44691 (CONF-881054–Vol.1, pp. 319-332) **Application of optimization modeling to groundwater remediation at US Department of Energy facilities.** Bakr, A.A. (NUS Corp. (USA)); Dal Santo, D.J.; Smalley, R.C.; Phillips, E.C. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

This paper outlines and explores the fundamentals of the current strategies for groundwater hydraulic and quality management modeling and presents a scheme for the application of such strategies to DOE facilities. The discussion focuses on the DOE-Savannah River Operations (DOE-SR) facility. Remediation of contaminated groundwater at active and abandoned waste disposal sites has become a major element of environmental programs. Traditional groundwater remediation programs (e.g., pumping and treatment) may not represent optimal water quality management strategies at sites to be remediated. Complex, interrelated environmental (geologic/geohydrologic), institutional, engineering, and economic conditions at a site may require a more comprehensive management strategy. Groundwater management models based on the principles of operations research have been developed and used to determine optimal management strategies for water resources needs and for hypothetical remediation programs. Strategies for groundwater remediation programs have ranged from the simple removal of groundwater to complex, hydraulic gradient control programs involving groundwater removal, treatment, and recharge.

44692 (CONF-881054–Vol.1, pp. 333-342) **Integration of aquifer restoration with remedial action at uranium mill tailings sites.** Loughead, J.S. (Jacobs Engineering Group (USA)); Brod, R.C.; Downs, W.F.; Sundberg, P.V. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Recently proposed groundwater standards for inactive (Title I) uranium mill sites will apply to both disposal cell performance and the cleanup of groundwater underlying the inactive site. Because the majority of Title I sites are either being designed or are already in construction, the Department of Energy (DOE) Uranium Mill Tailings Remedial Action (UMTRA) Project is evaluating potential impact to Title I sites if the groundwater cleanup standard (Subpart B) are promulgated as proposed. While the Nuclear Regulatory Commission (NRC) has stated a willingness to defer groundwater cleanup at Title I sites until after the standards are promulgated, the DOE Technical Assistance Contractor (TAC) is evaluating each UMTRA Project site and associated Remedial Action Plan (RAP) in light of the following questions: does the preferred remedy preclude or preempt future groundwater cleanup activities at the site; do near-term construction activities offer an opportunity to cost-effectively restore groundwater at the site? This paper reviews the elements considered, and presents the following general conclusions: aquifer restoration is generally not precluded or preempted by construction activities at UMTRA Project sites, while some construction activities (e.g., dewatering during excavation) offer the potential for assisting in groundwater cleanup, this potential is difficult to realize at some sites because of geochemical and hydraulic uncertainties.

44693 (CONF-881054–Vol.2, pp. 411-422) **SECURE system - An integrated waste management technique.** Grindstaff, J.W. (Bechtel National, Inc. (USA)); Feizollahi, F. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The SECURE system canisters are the heart of an integrated waste management technique developed by Bechtel for the safe disposal of low-level radioactive, chemical, and mixed wastes. The reinforced concrete SECURE canisters are approximately 7'-8" x 7'-8" x 8'-0" (2.3 m x 2.3 m x 2.4 m) high with 8" (20 cm) thick walls, floor, and cover. Additional protection is provided by a penetrating inorganic sealant. A canister will hold eighteen drums of packaged waste or almost 10 yd^3 (7.6 m^3) of non-packaged material. A filled canister, weighing up to 35 tons (32,000 kg), can be lifted and handled from the four eye-nuts embedded in the top corners. Once stacked, the canisters become interlocked to form a flexible concrete monolith that self-adjusts to natural ground movement. The monitoring system, referred to as the integrity verification system, allows for selective monitoring of the canisters. A Topical Report with design details, descriptions, and safety assessments of a generic SECURE waste disposal facility has been prepared. Several canisters have been fabricated to date: one as a prototype, one for testing, and five for actual use in LLRW disposal. This paper will describe the SECURE system for waste disposal with emphasis given to the SECURE canisters.

44694 (CONF-881054–Vol.2, pp. 423-434) **A field lysimeter demonstration to evaluate land burial of wastes containing depleted uranium.** Clapp, R.B. (Oak Ridge National Lab., TN (USA)); Francis, C.W.; Cline, J.E.; Jones, L.S. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

A new strategy for disposing of production wastes from the Oak Ridge Y-12 Plant is currently being developed. To provide data needed to implement the new strategy, the Y-12 Uranium Lysimeter Demonstration Project has been initiated to investigate the long-term leaching characteristics of five priority waste types containing depleted uranium. This report describes the field leaching component of the project. Twenty lysimeters will be built at a site west of the Oak Ridge Y-12 Plant during the winter and late spring of 1989. The lysimeters are designed to provide leaching data for 50 years although the current project is limited to 5 years. Three replicates of each waste type will be leached in separate lysimeters under natural rainfall conditions. The remaining lysimeters will be used for special tests (e.g., accelerated leaching and landfill simulation). The lysimeters will typically be 10 ft in height and 8 ft in diameter and contain about 11 yd^3 of waste. The volume of leachate generated, the concentration of uranium in the leachate, and other leachate characteristics (e.g., total organic carbon, pH, and dissolved oxygen) will be monitored in order to reveal more fully how these factors affect the leaching of uranium under landfill conditions. These data, in conjunction with pathways models, will be used to calculate impacts upon health and the environment that result from land disposal of uranium-containing wastes.

44695 (CONF-881054–Vol.2, pp. 435-446) **The diffusion of $^{14}CO_2$ through engineered barrier media.** Bauer, L.R. (Purdue Univ., Lafayette, IN (USA)); Landolt, R.R. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The diffusion of $^{14}CO_2$ through crushed tuff, bentonite and a crushed tuff/bentonite mixture was measured for two diffusion lengths. The ability of $^{14}CO_2$ to penetrate a microsilica-containing cement proposed for repository use was also examined. The specimens were subjected to uniaxially-applied compressive loads prior to the diffusion tests to simulate the onset of environmentally-induced microcracks. The results suggest that the presence of a tuff- or bentonite-based backfill would not significantly affect $^{14}CO_2$ release rates from a repository. Conversely, $^{14}CO_2$ diffusion through simulated cement seals can apparently only occur after severe physical damage has been induced. These results may have implications for the ability of a repository to comply with the applicable regulatory release limits for C-14.

44696 (CONF-881054–Vol.2, pp. 507-518) **The area resource file - An emergency response planning tool.** Mihlmester, P.E. (Applied Management Sciences, Inc. (USA)). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

Siting of hazardous waste treatment and disposal facilities requires careful advance planning to ensure adequate emergency response capability exists in close proximity to the facility. Similarly, transportation planning for hazardous wastes must account for possible accidents along the transportation route. The Area Resource File (ARF) can be a valuable tool in such planning exercises, particularly with regard to medical response capability. ARF is a nationwide medical geographic information system. The basic county-specific file is a massive data base containing more than 7,000 medical and health response-related variables at the county level for every county in the US. The data include detailed information on available health facilities and hospitals as well as physicians by specialty and other health professionals. Also included are related population characteristics, economic, and environmental data. ARF can facilitate detailed analysis of a potential hazardous waste treatment disposal site or transportation route by assessing the medical and emergency response capabilities, and the population at risk in a given location or set of locations. The fully automated features of ARF allow for easy manipulation of the data files. The paper describes ARF in greater detail, provides example outputs, and explains how ARF can be used in hazardous waste siting and transportation studies.

44697 (CONF-881054–Vol.2, pp. 563-572) **Copper alloys for low-level radioactive waste containers.** Kundig, K.J.A.; Greaves, J.D.; Dralle, C.W. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

Copper and copper-base alloys have been accepted or are under active consideration by several countries, including the US, as container and/or overpack materials for the disposal of spent nuclear fuel and high-level radioactive wastes. A considerable body of knowledge has consequently been amassed regarding, among other factors, the alloys' corrosion resistance, behavior in radiation environments, mechanical properties and fabricability. However surprisingly little attention has thus far been given to the exploitation of these materials in containers for the safe disposal of low-level radioactive wastes (LLW). This paper discusses selected copper alloys as candidates. Corrosion resistance and mechanical properties are analyzed with regard to waste form composition and disposal site environments. Fabricability and weldability are discussed in light of LLW container design requirements. The design, materials selection and fabrication of a new family of aluminum bronze LLW containers is described.

44698 (CONF-881054–Vol.2, pp. 635-647) **Minimum technical criteria and public involvement in siting hazardous waste facilities.** Tope, T.J. (Vanderbilt Univ., Nashville, TN (USA)); Parker, F.L.; Roth, J.A. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

Research suggests that certain regions of the US will face shortages of hazardous waste disposal facilities within the next decade. Two primary factors that interfere with state officials ability to develop an effective hazardous waste disposal facility siting program are inconsistencies in federal regulations and public opposition. This paper examines the technical and political inputs to the siting process. Specifically, it targets inconsistencies in federal regulations and the issue of reducing public opposition by deriving minimum site location standards from a review of standards of thirty-two states that are greater than existing federal regulations. The authors conclude that neither technical site-specific criteria nor public involvement alone can assure facility location approval. However, a combination of considerable host community involvement and technical site-specific criteria may increase the probability of site approval. A decision methodology based on these conclusions is proposed to aid developers in selecting sites for hazardous waste disposal facilities.

44699 (CONF-890854–8) **Waste characterization: What's on second?.** Schultz, F.J.; Smith,. M.A. Oak Ridge National Lab., TN (USA). Jul 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 11. annual DOE low level waste management conference; 22-24 Aug 1989. Order Number DE89016218/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Waste characterization is the process whereby the physical properties and chemical composition of waste are determined. Waste characterization is an important element which is necessary to certify that waste meets the acceptance criteria for storage, treatment, or disposal. Department of Energy (DOE) Orders list and describe the germane waste form, package, and container criteria for the storage of both solid low-level waste package, and container criteria for the storage of both solid low-level waste (SLLW) and transuranic (TRU) waste, including chemical composition and compatibility, hazardous material content (e.g., lead), fissile material content, radioisotopic inventory, particulate content, equivalent alpha activity, thermal heat output, and absence of free liquids, explosives, and compressed gases. At the Oak Ridge National Laboratory (ORNL), the responsibility for waste characterization begins with the individual or individuals who generate the waste. The generator must be able to document the type and estimate the quantity of various materials (e.g., waste forms – physical characteristics, chemical composition, hazardous materials, major radioisotopes) which have been placed into the waste container. Analyses of process flow sheets and a statistically valid sampling program can provide much of the required information as well as a documented level of confidence in the acquired data. A program is being instituted in which major generator facilities perform radionuclide assay of small packets of waste prior to being placed into a waste drum. 17 refs., 1 fig., 4 tabs.

44700 (CONF-890854–9) **A preliminary performance assessment for near-surface land disposal of low-level radioactive wastes.** Kocher, D.C.; Lee, D.W. Oak Ridge National Lab., TN (USA). [1989]. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From 11. annual DOE low level waste management conference; 22-24 Aug 1989. Order Number DE89016255/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses a preliminary performance assessment of facilities for near-surface land disposal of low-level radioactive wastes. The analysis assumes environmental conditions representative of the Oak Ridge Reservation (ORR). However, the assessment is not intended to provide realistic predictions of the performance of currently operating disposal facilities on the ORR or facilities that will be developed in the future, because the analysis is largely generic and involves many presumably conservative assumptions that often are used in the absence of data for specific sites and facilities and validated models of system performance. Rather, the assessment is intended primarily as a screening tool in planning for new disposal facilities on the ORR and in identifying important radionuclides for which a more realistic analysis is needed. Two types of waste disposal facilities are assumed: shallow trenches or above-grade tumuli. However, no credit is taken in the analysis for the waste-isolation capabilities of engineered disposal facilities and waste forms following loss of active institutional control. The analysis for the two types of facilities differs only in the model assumed for transport of radionuclides by water pathways. For trench disposal, radionuclides are transported to an underlying aquifer by infiltrating precipitation; for tumulus disposal, radionuclides are transported to nearby surface water by overland runoff.

44701 (CONF-8810239–Absts., pp. 2.81-2.97) **RCRA experience at West Valley.** Englert, J. (West Valley Nuclear Services Co., West Valley, NY (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

From 1966 to 1972, the only commercial facility to reprocess spent nuclear fuel in the United States operated near the town of West Valley in western New York. About 600,000 gallons of high-level radioactive waste resulting from that operation is now stored at the site in underground tanks. The West Valley Demonstration Project Act of 1980 (P.L. 96-368) gave the Department of Energy

(DOE) the responsibility for solidifying this waste for final disposal. In 1983, the Department selected borosilicate glass as the waste form and the slurry-fed ceramic melter (BFCM) as the solidification process. The melter, installed in late 1984, and its auxiliary systems are being operated to verify technical soundness and to generate nonradioactive samples for testing. Once technical acceptability of the integrated system is confirmed, the shield walls will be installed in preparation for radioactive high-level wastes in 1992, finishing in 1994. In January 1988, EPA determined that the Resource Conservation and Recovery Act (RCRA) was the overriding applicable Federal statute for the West Valley Demonstration Project. At this time, EPA directed the Project to file RCRA Parts A and B with the New York Department of Environmental Conservation. In June 1988, DOE Draft Order 5480 directed the Project to comply with technical and administrative requirements of RCRA and/or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

44702 (CONF-8810239–Absts., pp. 4.97-4.111) **West Valley New York Decontamination Project.** Gessner, R.F. (West Valley Nuclear Services Company, West Valley, NY (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The objective of the West Valley Demonstration Project is to demonstrate solidification and preparation of high-level waste for permanent disposal. The first phase of the project, scheduled for 1982 through 1994, concerns: (1) the cleanup of plant facilities for reuse in treating high-level waste, (2) the construction, testing, and qualification of the melter, and (3) vitrification of high-level waste. The second and last phase of the project is site closure. As of October 1988, high-level liquid waste is being processed at West Valley. Ion exchange removes 99.9% of the radioactivity from this liquid and converts the liquid to low-level waste. The low-level waste is then encapsulated in cement in square, 71 gallon drums. In addition, facilities are now being prepared for high-level waste vitrification and highly contaminated plant areas are getting cleaned up.

44703 (CONF-8810402–1) **Microstructural and mineralogical characterization of selected shales in support of nuclear waste repository studies.** Lee, S.Y.; Hyder, L.K.; Alley, P.D. Oak Ridge National Lab., TN (USA). [1988]. 33p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. From Meeting on clay microstructure; 4 Oct 1988. Order Number DE89015906/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Five shales were examined as part of the Sedimentary Rock Program evaluation of this medium as a potential host for a US civilian nuclear waste repository. The units selected for characterization were the Chattanooga Shale from Fentress County, Tennessee; the Pierre Shale from Gregory County, South Dakota; the Green River Formation from Garfield County, Colorado; and the Nolichucky Shale and Pumpkin Valley Shale from Roane County, Tennessee. The micromorphology and structure of the shales were examined by petrographic, scanning electron, and high-resolution transmission electron microscopy. Chemical and mineralogical compositions were studied through the use of energy-dispersive x-ray, neutron activation, atomic absorption, thermal, and x-ray diffraction analysis techniques. 18 refs., 12 figs., 2 tabs.

44704 (DOE/ID–22080) **Stratigraphy of the unsaturated zone at the Radioactive Waste Management Complex, Idaho National Engineering Laboratory, Idaho.** Anderson, S.R.; Lewis, B.D. Geological Survey, Idaho Falls, ID (USA). May 1989. 54p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (MISC–89076;USGS-WRI–89-4065). Order Number DE89016170/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

A complex sequence of layered basalt flows, cinders, and sediment underlies the Radioactive Waste Management Complex at the Idaho National Engineering Laboratory in southeastern Idaho. Wells drilled to 700 feet penetrate a sequence of 10 basalt-flow groups and 7 major sedimentary interbeds that range in age from about 100,000 to 600,000 years old. The 10 flow groups consist of 22 separate lava flows and flow-units. Each flow group is made up of from one to five petrographically similar flows that erupted from common source areas during periods of less than 200 years. Sedimentary interbeds consist of fluvial, lacustrine, and eolian deposits of clay, silt, sand, and gravel that accumulated during periods of volcanic inactivity ranging from thousands to hundreds of thousands of years. Flows and sediment are unsaturated to a depth of about 600 feet. Flows and sediment below a depth of 600 feet are saturated and make up the uppermost part of the Snake River Plain aquifer. The areal extent of flow groups and interbeds was determined from well cuttings, cores, geophysical logs, potassium-argon ages, and geomagnetic properties. Stratigraphic control was provided by four sequential basalt flows near the base of the unsaturated zone that have reversed geomagnetic polarity and high emission of natural gamma radiation compared to other flows. Natural gamma logs were used as a primary correlation tool. Natural-gamma emissions generally are uniform in related, petrographically similar flows and generally increase or decrease between petrographically dissimilar flows of different age and source. 16 refs., 24 figs., 2 tabs.

44705 (DOE/LLW–53T) **Planning for greater-confinement disposal: Volume 1, Alternatives and methods.** Low-level radioactive waste management handbook series. Gilbert, T.L.; Meshkov, N.K.; Schubert, J.P.; Trevorrow, L.E.; Yu, C. Argonne National Lab., IL (USA). Aug 1986. 108p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC07-76ID01570. Order Number DE89016018/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report presents technical information and planning methods for greater-confinement disposal (GCD) of low-level radioactive waste (LLW). The planning objective is to develop a disposal facility that will provide adequate protection of public health and safety by: (1) ensuring compliance with basic radiation protection criteria and (2) reducing detrimental effects from LLW–primarily health effects from exposure to ionizing radiation–to levels that are as low as reasonably achievable (ALARA). The objective of the report is to provide general information and methods for selecting a site and disposal technology that will best realize the planning objective. Volume 1 contains summary descriptions of the GCD alternatives and of the methods for selecting an optimum alternative. Volume 2 consists of appendices containing more detailed descriptions of the alternatives and discussions of the selection methodology.

44706 (DOE/LLW–58T) **Planning for greater-confinement disposal: Volume 2, Appendices.** Low-level radioactive waste management handbook series. Gilbert, T.L.; Meshkov, N.K.; Schubert, J.P.; Trevorrow, L.E. Argonne National Lab., IL (USA). Sep 1986. 142p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC07-76ID01570. Order Number DE89016017/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report presents technical information and planning methods for greater-confinement disposal (GCD) of low-level radio-active waste (LLW). The planning objective is to develop a disposal facility that will provide adequate protection of public health and safety by: (1) ensuring compliance with basic radiation protection criteria and (2) reducing detrimental effects from LLW – primarily health effects from exposure to ionizing radiation – to levels that are as low as reasonably achievable (ALARA). The objective of the report is to provide general information and methods for selecting a site and disposal technology that will best realize the planning objective. Volume I contains summary descriptions of the GCD alternatives and of the methods for selecting an optimum alternative. Volume II consists of appendices containing more detailed descriptions of the alternative and discussions of the selection methodology. 12 refs., 14 figs., 4 tabs.

44707 (DOE/LLW–76T) **Low-level radioactive waste volume reduction and stabilization technologies resource manual: National Low-Level Radioactive Waste Management Program.** Ebasco Services, Inc., Bellevue, WA (USA). Dec 1988. 340p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89015581/JAW. Available from NTIS, PC A15/MF A01 - OSTI; GPO Dep.

This manual on volume reduction and stabilization technologies is intended to serve as a resource document to policy personnel at the state or regional level. The manual provides concise descriptions of currently available and promising methods of volume

reduction and stabilization of low-level radioactive waste. Technologies in this manual include cement solidification, bituminization, evaporation, incineration, high-integrity containerization, shredding, and compaction and supercompaction. Each technology is discussed in detail in relation to how the technology works, its suitability for specific waste types, volume reduction factors typically obtainable, costs, its applicability to treatment of mixed waste, its commercial availability and its history of use. An annotated bibliography is included to allow for further independent research on the technologies. 78 refs., 19 figs., 34 tabs.

44708 (DOE/NE/44139–57) **Waste description and previtrification treatment activities at WVDP, HWVP, and DWPF.** Jain, V.; Barnes, S.M. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Feb 1989. 17p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89009016/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

In the United States, the high-level radioactive nuclear wastes are stored at Department of Energy (DOE) sites in South Carolina (Savannah River Plant - SRP), Washington (Hanford), Idaho (Idaho National Engineering Laboratory - ICPP) and New York (West Valley Site - WVDP). Current estimates indicate that 382,000 cubic metres of high-level radioactive wastes are stored in the above DOE facilities. The high-level radioactive waste inventory indicates most of the wastes stored have already undergone one or more treatments like neutralization, precipitation, etc. At SRP and Hanford, the acidic liquid waste from reprocessing of defense reactor fuel by PUREX process has been made alkaline by the addition of sodium hydroxide. At SRP, 128,800 cubic metres of alkaline wastes have been stored as alkaline liquid or supernatant, sludge, and salt-cake. At Hanford 240,000 cubic metres of alkaline waste are stored as neutralized current acid waste (NCAW), neutralized cladding removal waste (NCRW), plutonium finishing plant (PFP) waste, double-shell slurry (DSS), and complex concentrate wastes (CCW). At WVDP, 2320 cubic metres of neutralized PUREX and acidic THOREX wastes are stored. Current estimates indicate 11,900 cubic metres of high-level waste are stored at ICPP. Further details of the ICPP site are excluded in this report, as the final waste solidification processes have not yet been selected. This document reports the various waste pretreatment steps which are planned for the wastes which will be processed to yield a borosilicate glass waste form. 11 refs., 6 figs., 2 tabs.

44709 (DOE/RL–89-02) **Hanford Waste Vitrification Plant: Dangerous waste permit application.** USDOE Richland Operations Office, WA (USA). Jul 1989. 444p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE89016173/JAW. Available from NTIS, PC A19/MF A01 - OSTI; GPO Dep.

The Hanford Site is operated by the US Department of Energy-Richland Operations Office. The Hanford Site produces mixed waste (containing both radioactive and dangerous materials) from operations involved in the recovery and purification of special nuclear materials from reactor fuel elements and the research and development of advanced nuclear reactor concepts. The radioactive portion of mixed waste is interpreted by the US Department of Energy to be regulated under the Atomic Energy Act of 1954; the nonradioactive dangerous portion of mixed waste is interpreted to be regulated under the Resource Conservation and Recovery Act of 1976. The single dangerous waste permit identification number issued to the Hanford Site by the US Environmental Protection Agency and the Washington State Department of Ecology is US Environmental Protection Agency/State Identification Number WA 7890008967. This identification number encompasses a number of waste management units within the Hanford Site. Westinghouse Hanford Company is a major contractor to the US Department of Energy-Richland Operations Office and serves as co-operator of the Hanford Waste Vitrification Plant, the waste management unit addressed by this permit application. The Hanford Site currently has mixed waste resulting from various processing operations stored in underground storage tanks. The Hanford Waste Vitrification Plant will be constructed and operated to process the existing and future high-activity fraction of mixed waste stored in these underground tanks. The facility will solidify pretreated tank waste into a glass product which will be packaged for disposal in a national repository. 48 refs.

44710 (DOE/RL–89-03) **616 Nonradioactive Dangerous Waste Storage Facility Dangerous Waste Permit Application.** USDOE Richland Operations Office, WA (USA). 31 Jul 1989. 383p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE89016174/JAW. Available from NTIS, PC A17/MF A01 - OSTI; GPO Dep.

The Hanford Site is operated by the US Department of Energy-Richland Operations Office. The 616 Nonradioactive Dangerous Waste Storage Facility receives and stores nonradioactive dangerous waste from various Hanford generating units until the waste can be transported offsite for treatment, storage, and/or disposal. Storage of this nonradioactive dangerous waste is regulated under the Resource Conservation and Recovery Act of 1976. The single dangerous waste permit identification number issued to the Hanford Site by the US Environmental Protection Agency and the Washington State Department of Ecology is US Environmental Protection Agency/State Identification Number WA 7890008967. This identification number encompasses a number of waste management units within the Hanford Site. Westinghouse Hanford Company is a major contractor to the US Department of Energy-Richland Operations Office and serves as co-operator of the 616 Nonradioactive Dangerous Waste Storage Facility, the waste management unit addressed by this permit application. The 616 Nonradioactive Dangerous Waste Storage Facility Dangerous Waste Permit Application consists of both a Part A and a Part B permit application. An explanation of Part A revisions associated with this waste management unit, including the one submitted with this document, is provided at the beginning of the Part A Section. 57 refs.

44711 (DOE-RW–89.029) **Report of a seminar on natural environmental change.** Department of the Environment, London (UK); Dames and Moore, London (UK). Jan 1989. 114p. (CONF-8804292–: Seminar on natural environmental change: processes affecting the deep disposal of radioactive waste in Britain, 21 Apr 1988; TR-DM–13). Order Number DE89633767/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This document reports the presentations given at a seminar on Natural Environmental Change: Processes Affecting the Deep Disposal of Radioactive Waste in Britain and the ensuing discussion. Following introductory summaries of the Department of the Environment research programme into radioactive waste management and Nirex-funded research into long-term environmental change, four topical presentations were given, namely, "Climatic Change", "Surface Processes", and "Stress and Seismicity". These presentations and the consequent discussion have served to clarify many key aspects of long-term environmental change and have provided direction to the ongoing studies of the effects of environmental change on the performance of deep radioactive waste disposal facilities. (author).

44712 (DOE/RW–0225-1) **Quarterly report on program cost and schedule.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Jul 1989. 35p. Sponsored by U.S. DOE Radioactive Waste Management. Available from OSTI.

This report is intended to provide a summary of the cost and schedule performance for the Civilian Radioactive Waste Management Program. Performance data are presented for each of the major program elements. Also included in this report is the status of the Nuclear Waste Fund revenues and disbursements. This report includes project performance data reported through March 1989.

44713 (DOE/RW–0238) **The role of the monitored retrievable storage facility in an integrated waste management system.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). 1989. 2p. Sponsored by U.S. DOE Radioactive Waste Management. Available from OSTI.

The US Department of Energy (DOE) supports the development of a Monitored Retrievable Storage (MRS) facility as an integral part of the national high-level radioactive waste management system. The MRS facility will receive spent fuel from the utilities, store the fuel if necessary, and ship the fuel to the repository, as their schedules require. By receiving, storing and scheduling shipment of spent fuel at an MRS facility, the DOE has concluded that the overall waste system will benefit from enhanced systems development and

system performance. Specifically, the DOE could better meet its objectives of timely disposal, timely waste acceptance, schedule confidence and system flexibility.

44714 (DOE/RW–0239) **The DOE position on the MRS [monitored retrievable storage] facility.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Jun 1989. 26p. Sponsored by U.S. DOE Radioactive Waste Management. Available from OSTI.

The DOE supports the development of an MRS facility as an integral part of the waste-management system because an MRS facility would allow the DOE to better meet its strategic objectives of timely disposal, timely and adequate waste acceptance, schedule confidence, and system flexibility. This facility would receive, store, and stage shipments of intact spent fuel to the repository and could be later expanded to perform additional functions that may be determined to be beneficial or required as the system design matures. Recognizing the difficulty of DOE-directed siting through national or regional screening, the DOE prefers an MRS facility that is sited through the efforts of the Nuclear Waste Negotiator, especially if the siting negotiations lead to linkages that allow the advantages of an MRS facility to be more fully realized. Even if such revised linkages are not achieved, however, the DOE supports the development of the MRS facility. 23 refs.

44715 (DOE/RW–0244) **Draft reclamation program plan for site characterization: Yucca Mountain project.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Aug 1989. 37p. Sponsored by U.S. DOE Radioactive Waste Management. Available from OSTI.

As part of its obligations under the Nuclear Waste Policy Act, as amended, the US Department of Energy (DOE) has developed an environmental program that is to be implemented during site characterization at the Yucca Mountain site. This site is proposed for the location of the nation's first high-level radioactive waste repository. A program for the reclamation of areas disturbed by site characterization is part of the overall environmental program for that site. This Reclamation Program Plan (RPP) describes the reclamation policy of the DOE for the Yucca Mountain site and presents an overview of the reclamation program. The RPP also provides an overview of the reclamation needs relative to site characterization; a review of legislation and requirements pertinent to reclamation; and a review of previous commitments made by the DOE to certain types of reclamation activities. The objective of the DOE reclamation program at Yucca Mountain is to return land disturbed by site-characterization activities to a stable ecological state with a form and productivity similar to the predisturbance state. The DOE will take all reasonable and necessary steps to achieve this objective. 19 refs., 2 tabs.

44716 (DOE/S–0070) **Environmental restoration and waste management: Five-Year Plan.** Middleman, L.I. (ed.). USDOE Office of the Secretary, Washington, DC (USA). [1989]. 441p. Sponsored by U.S. DOE Management & Administration. Order Number DE89015619/JAW. Available from NTIS, PC A19/MF A01 - OSTI; GPO Dep.

The purpose of this Five-Year Plan is to establish an agenda for compliance and cleanup against which progress will be measured. DOE is committed to an open and participatory process for developing a national priority system for expenditure of funds. This system will be based on scientific principles and risk reduction in terms that are understandable to the public. The Plan will be revised annually, with a five-year planning horizon. For FY 1991–1995, this Plan encompasses total program activities and costs for DOE Corrective Activities, Environmental Restoration, Waste Management Operations, and Applied R&D. It addresses hazardous wastes, radioactive wastes, mixed wastes (radioactive and hazardous), and sanitary wastes. It also addresses facilities and sites contaminated with or used in the management of those wastes. The Plan does not include the Safety and Health Program (Office of the Assistant Secretary for Environment, Safety, and Health) or programs of the Office of Civilian Radioactive Waste Management. It does include the annual Defense Programs contribution to the Nuclear Waste Fund for disposal of defense high-level waste and research toward characterizing the defense waste form for repository disposal.

44717 (DOE/WIPP–87-010) **Brine Sampling and Evaluation Program: Phase 2 report.** Deal, D.E.; Case, J.B.; Deshler, R.M.; Drez, P.E.; Myers, J.; Tyburski, J.R. Westinghouse Electric Corp., Carlsbad, NM (USA). Engineering and Repository Technology Dept. Dec 1987. 198p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC04-86AL31950. Order Number DE89017240/JAW. Available from NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.

The Brine Sampling and Evaluation Program (BSEP) Phase II Report is an interim report which updates the data released in the BSEP Phase I Report. Direct measurements and observations of the brine that seeps into the WIPP repository excavations were continued through the period between August 1986 and July 1987. That data is included in Appendix A, which extends the observation period for some locations to approximately 900 days. Brine observations at 87 locations are presented in this report. Although WIPP underground workings are considered "dry," small amounts of brine are present. Part of that brine migrates into the repository in response to pressure gradients at essentially isothermal conditions. The data presented in this report is a continuation of moisture content studies of the WIPP facility horizon that were initiated in 1982, as soon as underground drifts began to be excavated. Brine seepages are manifested by salt efflorescences, moist areas, and fluid accumulations in drillholes. 35 refs., 6 figs., 11 tabs.

44718 (EPRI-NP–5680) **Below regulatory concern owners group: Individual and population impacts from BRC [below regulatory concern] waste treatment and disposal.** Murphy, E.S.; Rogers, V.C. Electric Power Research Inst., Palo Alto, CA (USA); Rogers and Associates Engineering Corp., Salt Lake City, UT (USA). c Aug 1989. 132p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Using the IMPACTS-BRC and PRESTO-EPA-POP codes, researchers calculated potential individual and population doses for routine and unexpected radiation exposures resulting from the transportation and disposal of BRC nuclear power plant wastes. These calculations provided a basis for establishing annual curie and radionuclide concentration limits for BRC treatment and disposal. EPRI has initiated a program to develop a petition for rulemaking to NRC that would allow management of certain very low activity nuclear power plant waste types as below regulatory concern (BRC), thus exempting these wastes from requirements for burial at licensed low-level radioactive waste disposal facilities. The technical information required to support the BRC petition includes an assessment of radiologic impacts resulting from the proposed exemption, based on estimated individual and population doses that might result from BRC treatment and disposal of nuclear power plant wastes. 13 figs., 31 tabs.

44719 (EPRI-NP–5685) **Below regulatory concern owners group: BRC waste variability evaluation: Final report.** Vance, J.N.; Wanless, J. Electric Power Research Inst., Palo Alto, CA (USA); Vance and Associates, Ruidoso, NM (USA); National Nuclear Corp., Mountain View, CA (USA). c Aug 1989. 112p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Conservative estimates of radionuclide concentrations in BRC waste from commercial nuclear power stations were established in this study. These concentrations are necessary input parameters for dose assessments that will become part of the technical basis for a petition for rulemaking on BRC waste disposal. The NRC policy statement on below regulatory concern (BRC) waste disposal requires that the radiologic properties of the waste proposed to be disposed of as BRC be characterized on a national basis. The characterization is to include the concentrations or contamination levels of the radionuclides expected to be in the waste. The variability in these properties is to be assessed to justify the appropriate parameters used for impact analyses. We evaluated the variability of the radiological properties of BRC wastes generated at nuclear power plants and evaluated average activity concentrations in BRC waste types and waste mass or volume distributions as a function of activity concentration. 24 figs., 27 tabs.

44720 (EPRI-NP–5934, pp. 9, Paper 6) **Status of the Richland and Beatty low level radioactive waste disposal facilities.**

Crase, A. Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Both sites are open and accepting waste. The state of Washington has recently renewed our Richland facility license on January 17, 1987. The Beatty, Nevada facility is in a renewal process which is expected to last until at least winter. Interim amendments at Nevada, however, have made Nevada very attractive in that waste forms are consistent with those received at Washington and South Carolina. In addition, all three facilities now accept HK's.

44721 (EPRI-NP–5934, pp. 11.3-11.32) **Design and construction of solidification and dewatering facility at Alabama Power Company's Farley Nuclear Plant.** Farnsworth, P. (Farley Nuclear Plant, Ashford, AL (USA)). Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The approximate total cost of the structure and supporting piping systems is estimated to be 4.1 million dollars. Total dose savings per year could be as high as 70 man Rem for resin processing alone. The ability to store refueling equipment, process contaminated oils, load and unload trucks and containers regardless of weather conditions and support repair work on equipment greatly enhances the cost effectiveness of the project. It will take at least one year of operation of the facility to accurately assess the true cost savings to Alabama Power Company. The morale factor for the Waste and Decon Group has escalated measurably due to the dose reduction to our personnel. Plant and company management are well pleased due to the possibility of a spill or release to the environment has been eliminated which was on intangible cost. Facility construction has been completed as of this date and resin transfer anticipated within the next few days. Some of the problems encountered in planning and constructing this solidification and dewatering facility are presented. A safety evaluation for the facility is included in the appendix.

44722 (EPRI-NP–5934, pp. 3.3-3.14) **Radwaste precoat filter optimization at Grand Gulf.** Michalski, M.B. (System Energy Resources, Port Gibson, MS (USA)). Electric Power Research Inst., Palo Alto, CA (USA); BVC Consultants, Inc., Sun City Center, FL (USA). Oct 1988. (CONF-8707200–: 9. EPRI radwaste workshop, 19-21 Jul 1987). In *Proceedings: 1987 EPRI radwaste workshop.* Order Number DE89002017/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Like most BWR's, precoat filters are used in the Grand Gulf radwaste system for the treatment of floor and equipment drain wastes. The precoat and body feed materials from these filters generally contribute a large fraction of the total solid waste volume which must be shipped to a low-level waste disposal site. At Grand Gulf, the filter sludges from these two filters constituted nearly half of the total wet waste prior to the optimization of the filters. This paper describes a joint SERI-EPRI program to optimize the performance of the Grand Gulf radwaste filters. The objective of the optimization effort is to reduce the volume of wastes produced by the two radwaste filters using operational changes to the filters rather than hardware or equipment modifications. This paper reports the results of laboratory and full-scale testing at Grand Gulf to optimize the equipment and floor drain filters.

44723 (EPRI-NP–6453) **Proceedings: 1988 EPRI radwaste workshop.** Nelson, L. Electric Power Research Inst., Palo Alto, CA (USA); Ascent Administrative Services, Boulder, CO (USA). c Jun 1989. 150p. Sponsored by Electric Power Research Institute. (CONF-8807181–: 10. EPRI radwaste workshop, 18-20 Jul 1988). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The proceedings of the tenth EPRI radwaste workshop are presented. The workshop presentations followed by discussion sessions addressed the following pertinent issues: wet waste minimization; non-routine waste generation; dry active waste volume reduction and regulatory affairs. The focus of the workshop is to provide a forum for exchange of practical operational experiences as they relate to radwaste management. In the pursuit of this goal, the radwaste professionals in the nuclear industry are the individuals who bring forth their knowledge and expertise to make this workshop valuable. Presentations on non-routine waste management included: a summary of results from an EPRI project on the typical generation of abnormal wastes specific experience on the fuel pool cleanup of a hydraulic fluid spill at Millstone-2, decontamination of low pressure turbine disc blades, and processing of control rod blades for disposal. Three utilities presented lectures on their programs for DAW waste minimization. Wet waste lectures included presentations on: radioactive waste oil processing, resin cement solidification vs. liquid processing, and radwaste resin drying vs. dewatering. The final session was on regulatory affairs. This session serves as an opportunity to update plant staff on current and changing regulations as they pertain to LLW management.

44724 (HEDL–7641) **2000-hour stress-corrosion cracking tests on 90-10 cupronickel in simulated Hanford groundwater.** Mills, W.J. Hanford Engineering Development Lab., Richland, WA (USA). Feb 1987. 27p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-87RL10930. Order Number DE89016058/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Self-loaded fracture mechanics specimens were tested in simulated groundwater at 150°C to evaluate the susceptibility of 90-10 cupronickel to environmentally enhanced cracking. The test duration was 2000 hours. Electron fractographic evidence indicated that no stress corrosion cracking occurred during the test. Compliance methods demonstrated that a substantial amount of crack extension did not occur during the 2000-hour exposure, but this method was insensitive to detecting crack growth increments less than 0.030 inch. Conventional macroscopic examination of fracture surfaces could not be used to determine if any crack extension occurred during the test because stains were observed beyond the original precrack. The stains were attributed to artifacts associated with postcracking procedures. 7 refs., 11 figs., 3 tabs.

44725 (INIS-mf–11996) **Nuclear waste management is not the heel of Achilles but rather an advantage of the peaceful use of nuclear energy.** PreussenElektra. Presseinformation. Kraemer, H. Preussische Elektrizitaets-A.G. (Preussenelektra), Hannover (Germany, F.R.). 1988. 4p. (In German). (CONF-8812104–: VDEW press symposium on energy policy, 7 Dec 1988). Order Number DE89911508/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

An unbiased analysis of the entire situation dispels all doubt about the feasibility and realisation of the ultimate disposal of radioactive waste, so that the government's fuel cycle concept still remains valid. Practical work for realisation of the waste management concept is making progress, although there have been difficulties and disappointments. The responsible Federal Minister is well aware of the fact that his ministry plays the leading part, and that it is one of his obligations to create the organisational framework necessary for realising the concepts. The establishment of the Federal Office for Radiation Protection has to be seen in this context. (orig./HSCH).

44726 (IPEN-PUB–236) **Immobilized waste leaching.** Suarez, A.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 24p. (In Portuguese). Order Number DE89636495/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The main mechanism by which the immobilized radioactive materials can return to biosphere is the leaching due to the intrusion of water into the repositories. Some mathematical models and experiments utilized to evaluate the leaching rates in different immobilization matrices are described. (author).

44727 (IPEN-PUB–237) **Quality control in the radioactive waste management.** Rzyski, B.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 43p. (In Portuguese). Order Number DE89636496/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Radioactive waste management as in industrial activities must mantain in all steps a quality control programme. This control extended from materials acquisition, for waste treatment, to the package deposition is one of the most important activities because it aims to observe the waste acceptance criteria in repositories and allows to guarantee the security of the nuclear facilities. In this work basic knowledges about quality control in waste management and some examples of adopted procedures in other countries are given. (author).

44728 (IPEN-PUB–238) **Radioactive waste treatment of the Nuclear and Energetic Research Institute (IPEN).** Suarez, A.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 26p. (In Portuguese). Order Number DE89636493/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Waste treatment management since the installation at IPEN of the first brazilian research reactor IEA-R1 is shown. The institute is responsible for the treatment of its own wastes as well for those coming external institutions, mainly due to the application of radiosotopes in medicine and industry. (author).

44729 (IPEN-PUB–239) **Acceptance criteria for radioactive waste deposition.** Rzyski, B.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 24p. (In Portuguese). Order Number DE89636497/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The disposal of low-and intermediate level radioactive waste in either shallow ground or rock cavities must be subjected to special guidelines which are used by national authorities and implementing bodies when establishing and regulating respositories. These informations are given by the acceptance criteria and will depend on specific site conditions and optmized procedures. (author).

44730 (IPEN-PUB–240) **Radiaoctive waste packaging for transport and final disposal.** Suarez, A.A. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 21p. (In Portuguese). Order Number DE89636498/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Prior and after the conditioning of radioactive wastes is the packaging design of uppermost importance since it will be the first barrier against water and human intrusion. The choice of the proper package according waste category as well criteria utilized for final disposal are shown. (author).

44731 (IPEN-PUB–242) **Solid and liquid radioactive waste treatment.** Rzyski, B.M. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 90p. (In Portuguese). Order Number DE89636494/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The technology for the treatment of low - and intermediate-level radioactive solid and liquid wastes is somewhat extensive. Some main guidance on the treatment methods are shown, based on informations contained in technical reports and complementary documents. (author).

44732 (LA–11511-MS) **Hydrologic characteristics of the Bandelier Tuff as determined through an injection well system.** Purtymun, W.D.; Enyart, E.A.; McLin, S.G. Los Alamos National Lab., NM (USA). Aug 1989. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89016020/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Injection wells were used to determine some of the hydrologic transmitting characteristics of the unsaturated Bandelier Tuff. At site 1, a 60-ft injection well with a 5-ft injection zone was used to conduct four tests. These preliminary tests were made in order to design an injection-well monitoring system that could track the movement of fluids in the tuff. At site 2, a second injection well with a 10-ft injection zone and seven observation holes was used to monitor the movement of 335,000 gal. of water injected into the tuff. The initial injection rate at site 2 was 5.8 gallons per minute (gpm), but that rate gradually declined to 0.4 gpm after 89 days of the test; 289 days after the test ended, the pear-shaped nephol (the shape of moisture injected into the tuff) reached a maximum depth of 210 ft and had a diameter of about 120 ft. A second test at site 2 indicated that intermittent use of an injection system would allow for short periods of higher injection rates, thereby extending the life of the system. Finally, a third test at site 2 was made using a 50-ft injection zone, which resulted in an injection rate of 15.8 gpm, or about 3 times the initial rate achieved when a 10-ft injection zone was used. 8 refs., 10 figs., 5 tabs.

44733 (LA–11605-MS) **Study plan for water movement test: Site Characterization Plan Study 8.3.1.2.2.2.** Norris, A.E. Los Alamos National Lab., NM (USA). Sep 1989. 21p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-36. Order Number DE89016019/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The water movement tracer test is designed to produce information derived from isotopic measurements of soil and tuff samples collected from Yucca Mountain that is pertinent for assessing the performance of a nuclear waste repository. Measurements of chlorine isotropic distributions will help characterize the percolation of precipitation into the unsaturated zone. The ^{36}Cl in the unsaturated zone occurs from atmospheric fallout of ^{36}Cl produced by cosmic-ray secondaries reacting with ^{40}Ar and, to a lesser extent, with ^{36}Ar. It also occurs as global fallout from high-yield nuclear weapons tests conducted at the Pacific Proving Grounds between 1952 and 1962. When chloride ions at the surface are washed underground by precipitation, the radioactive decay of the ^{36}Cl in the chloride can be used to time the rate of water movement. The ^{36}I half-life of 301,000 yr permits the detection of water movement in the range of approximately 50,000 to 2 million years. These data are part of the input for developing numerical models of ground water flow at this site. 5 refs., 4 figs., 4 tabs.

44734 (LA-UR–89-1939) **Using voice input/output in the processing of plutonium.** Phelan, P.F.; Fullerton, R. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8909147–2: American Voice Input/Output Society meeting, Sep 1989). Order Number DE89014262/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A new method for weighing samples of plutonium dioxide is described. An efficient, reliable method of weighing samples and batches is important because a sample and batch may need to be weighed and treated a number of times before they are sufficiently pure for use. Accurate weighing and recording of all plutonium dioxide coming into or leaving the laboratory is also needed to satisfy accountability requirements. In the past, the necessary data were recorded by hand – a time-consuming, error-prone procedure. This method was further complicated because plutonium cannot be handled safely outside a glovebox, and two operators were needed to record the data: one to weigh the plutonium dioxide and the other to record the weight. When vocal input to a computer is used, two operators are not needed to record data. An operator still handles the material in a glovebox, and measurement is still done within a glovebox, but with automated equipment, thus reducing the risk of radiation exposure and eliminating the need for two operators. This method allows the operator to determine from the glovebox monitor if the weights recorded are reasonable. If not, he can interrupt the procedure and reweigh the material. With computer recording of data, the chance for error is greatly reduced. All data are transmitted directly from the balance to the computer, where the result is displayed on monitors and recorded on a disk. 3 figs.

44735 (LA-UR–89-2541) **Formation, characterization, and stability of plutonium (IV) colloid: A progress report.** Hobart, D.E.; Morris, D.E.; Palmer, P.D.; Newton, T.W. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by DOE/ER;DOE/RW. DOE Contract W-7405-ENG-36. (CONF-890928–1: Nuclear waste isolation in the unsaturated zone: FOCUS '89, 18-21 Sep 1989). Order Number DE89015288/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Plutonium is expected to be a major component of the waste element package in any high-level nuclear waste repository. Plutonium(IV) is known to form colloids under chemical conditions similar to those found in typical groundwaters. In the event of a breach of a repository, these colloids represent a source of radionuclide transport to the far-field environment, in parallel with the transport of

dissolved waste element species. In addition, the colloids may decompose or disaggregate into soluble ionic species. Thus, colloids represent an additional term in determining waste element solubility limits. A thorough characterization of the physical and chemical properties of these colloids under relevant conditions is essential to assess the concentration limits and transport mechanisms for the waste elements at the proposed Yucca Mountain Repository site. This report is concerned primarily with recent results obtained by the Yucca Mountain Project (YMP) Solubility Determination Task pertaining to the characterization of the structural and chemical properties of Pu(IV) colloid. Important results will be presented which provides further evidence that colloidal plutonium(IV) is structurally similar to plutonium dioxide and that colloidal plutonium(IV) is electrochemically reactive. 13 refs., 7 figs.

44736 (LA-UR–89-2573) **The use of chlorine isotope measurements to trace water movements at Yucca Mountain.** Norris, A.E. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-36. (CONF-890928–2: Nuclear waste isolation in the unsaturated zone: FOCUS '89, 18-21 Sep 1989). Order Number DE89015278/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The rates of water movements in the tuffs at Yucca Mountain are important for assessing the performance of a potential high-level nuclear waste repository. Measurements of cosmogenic 3.0×10^5 yr ^{36}Cl in tuff from the unsaturated zone and in water from the saturated zone can provide information about water movements over times of 10^{15} to 10^6 years. The data derived from the analysis of cuttings from a dry-drilled hole at Yucca Mountain indicate the presence of a ^{36}Cl background that must be taken into account for proper interpretation of the ^{36}Cl interpretation of the ^{36}Cl results. Similarly, the ^{36}Cl measured in water from the saturated zone requires additional work for correct interpretation. Fallout of ^{36}Cl from nuclear weapons tests between 1952 and 1962 provided a tracer for an infiltration study. Measurements of the ^{36}Cl bomb pulse in tuffs from the unsaturated zone show potential for tracing recent water flow in faults and fractures. 5 refs.

44737 (NSS/R–134) **Geomorphological processes in Britain in a periglacial age.** Pitty, A.F. United Kingdom Nirex, Ltd., Harwell (UK). Dec 1988. 44p. (HL–89/1080). Order Number DE89636499/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Significant changes in geomorphological processes can be anticipated over the timescales relevant to the Safety Assessments being formulated by United Kingdom Nirex Ltd. The opening sections of this Report emphasise the intrinsic uncertainties concerning the study and interpretation of periglacial phenomena, both in their present-day setting, and as presumed relict features in the British Isles. A section illustrates how emphases have veered and varied in this area of study. An implication, with particular reference to the British Isles, is that the study of periglacial phenomena is, itself, subject to significant short-term changes. The Report reviews the climate of a periglacial environment, emphasising the difficulties involved in translations from present-day analogue areas, which often have intrinsic differences, when compared with the British Isles. The significance of frost penetration, microclimate and snow cover is explained. (Author).

44738 (NUKEM-FuE–88039) **Disposal and solidification of LAW/MAW in underground caverns, phase 4. Final report.** Ganser, B.; Dedegil, Y. Nuklear-Chemie und -Metallurgie G.m.b.H. (NUKEM), Hanau (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). May 1989. 132p. (In German). Contract BMFT KWA 7605 0. Order Number DE89915148/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

In this report the concluding phase IV of the project for the containerless disposal of LAW/MAW-concentrate is described. This phase IV became necessary because of two pipe pluggings during phase III to demonstrate the technical performability. Compared with phase III the following plant and process modifications were performed: partially filled cross section of the feed pipe ('snifting air'), increased feed pipe diameter (47.4 to 59.4 mm), increased plant throughput (12 t/h to 24 t/h), feed pipe instrumentation (density, flow, pressure). In the pilot scale the modified process was tested in a 100 m-pipe (Asse, Blindschacht 4). The technical demonstration was performed by the 1000 m pipe from the above-day plant to the prototype cavern of the Asse salt mine. Overall more than 1000 t of product have been feeded within several shifts in successful performance. (orig.).

44739 (NUREG/CP–0098-Vol.1, pp. 349-365) **Contamination releases from HEPA filters under high temperature operating conditions.** Ammerich, M. (Commissariat a l'Energie Atomique, Gif-Sur-Yvette (France)); Briand, A.; Laborde, J.C.; Mulcey, Ph.; Savornin, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

The High Efficiency Particulate Air (HEPA) filters installed in the air cleaning systems of nuclear facilities could, in the case of an accident, be exposed to operating conditions extremely different from those typical for normal operation. One of these is high air temperature in case of fires. An experimental program was initiated on the test facility SIMOUN to evaluate the hazard of a contamination release from radioactive aerosols deposited on a filter submitted to thermal stresses. The radioactive release rate is determined using aerosols of soda fluorescein (up to temperatures of 175°C) or sodium chloride (up to temperatures of 400°C) both tagged with technetium (^{99m}Tc). The influence of temperature according to different parameters such as design and initial state of the filters (new filters from the manufacturer, loaded filters recovered after several years of operation on a nuclear facility) has been studied. The paper first describes the system of measuring the radioactive release rate and the associated experimental program. The preliminary results are then discussed. Contamination releases are observed from 175°C and cannot be disassociated from a smoke emission phenomenon resulting from thermal degradations.

44740 (NUREG/CP–0098-Vol.1, pp. 366-384) **Effect of age on the structural integrity of HEPA filters.** Johnson, J.S. (Lawrence Livermore National Laboratory, CA (USA)); Beason, D.G.; Smith, P.R.; Gregory, W.S. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. DOE Contract W-7405-ENG-48. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

All of the controls on high-efficiency particulate air (HEPA) filters are based on rigid manufacturing standards with regard to filtration efficiency, temperature performance, pressure integrity, and strength. Third-party inspection and testing by the US Department of Energy increases the reliability of new HEPA filters, but only routine in-place testing is used to assure that an aging filter performs adequately. In 1980 the Lawrence Livermore National Laboratory initiated a small evaluation to determine if age has a significant effect on the structural integrity of HEPA filters. A series of used uncontaminated filters dating back to 1965 was obtained for these tests. Tensile strength tests on the old media indicated a decrease in strength. To provide additional measurement of the filters' overall strength, several of these aged filters were subjected to pressure pulses equivalent to the NRC Region I tornado pulses and shock wave over pressures. Data from these tests indicate a decrease in breaking pressure of from 25-50%. A large increase in complete filter pack blow-out during the simulated NRC Region I tornado tests was also observed. The preliminary results indicate the need for an administrative lifetime for HEPA filters used in critical nuclear facilities. Due to the unique conditions in each facility, different administrative lifetimes may be necessary.

44741 (NUREG/CP–0098-Vol.1, pp. 386-408) **Review of nuclear air treatment system related License Event Reports for the period 1985 - 1987.** Jacox, J.W. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research;

Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

This paper will continue the review of HVAC/NATS related LERS presented at past Air Cleaning Conferences by Dr. D. W. Moeller and his associates. The general approach and format are similar. LER abstracts from mid 1985 through 1987 were reviewed and those related to HVAC/NATS classified and analyzed. The categories were jointly developed by Dr. Moeller, Dr. Casper Sun and myself. In appropriate cases both primary and secondary categories fora problem are given. A basic listing by category and brief statistical review are presented. Additionally a number of categories are discussed in some detail. The categories chosen for specific review are intended to highlight particular problem areas. NUREG/CR-2000 License Event Report (LER) Compilation is the basis for the initial review and coding. In essentially all cases where an LER is classified as of interest the complete LER was obtained and reviewed in full. The intent of this paper is to provide a basis for the industry to document and analyze problem areas that require additional attention. It appears that about 15% of all LERS in the subject period are HVAC/NATS related. This figure is generally consistent with those reported at the 17th DOE Nuclear Air Cleaning Conference. It is hoped that such attention will allow additional resources to be allocated to upgrade systems, procedures and training as well as in some cases government regulation.

44742 (NUREG/CP–0098-Vol.1, pp. 572-588) **Effects of temperature and humidity on the aging of TEDA impregnated charcoals.** Billinge, B.H.M. (Central Electricity Generating Board, Surrey (England)); Broadbent, D. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

Samples of triethylene diamine (TEDA) impregnated 207B carbon have been aged for up to 1000 hours at temperatures in the range 40° to 70°c and at relative humidities of 50% and 90%. The rate of aging (in terms of methyl iodide-131 trapping efficiency) increases progressively as the temperature is raised above 50°C and also as the relative humidity is increased; below 50°C however the aging rate is relatively low, even at 90% RH. A parallel examination by temperature programmed desorption of the growth of surface oxygen groups with aging indicates that, unlike KI impregnated carbons, the groups formed on the TEDA carbons are not linked to the decline in performance. Also, the presence of an amine, which, as a group, are generally regarded as anti-oxidants, does not reduce the rate of surface oxidation. The rate of aging of TEDA carbons has been shown to follow the increase in the partial pressure of water above the sample and it is proposed that TEDA carbon aging could be caused by loss of TEDA either by a process akin to steam distillation, or by reaction with or catalysis by water, to form a less efficient impregnant.

44743 (NUREG/CP–0098-Vol.1, pp. 602-618) **Study on adsorption characteristics and deterioration patterns of an impregnated active carbon under a simulated service condition of the filtering system at a nuclear power plant.** Kim, You Sun (Korea Advanced Energy Research Institute, Chung-Nam). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

In order to study the relative adsorption pattern of organic iodides with an impregnated active carbon, organic iodides were reacted with TEDA(Triethylenediamine) in presence of methanol or hydrocarbons. The prepared salts or complexes were subjected to the radioisotope exchange reaction with $CH_3\ ^{131}I$, which could show the tendency of these compounds towards an isotopic exchange reaction. 1:1 organic salts were further prepared to confirm the adsorption pattern of an impregnated carbon (TEDA + KI system) under a dried air flow at 50°C. Impregnated active carbons such as KI_3, TEDA + KI, and Dimethyl iodide of TEDA were subjected to the deterioration study under ASTM D 3803-86 conditions. A severe deterioration was observed in case of KI_3, whereas it was relatively minor in cases of TEDA + KI and Dimethyl iodide of TEDA. The deteriorated samples were subjected to the study of radioactive methyl iodide penetration. Under the condition of ASTM D 3803-86 method A, the deteriorated sample could not show the penetration higher than that of the none deteriorated sample, but the penetration of the former sample was markedly increased as the methyl iodide's concentration was increased, which indicated a significant damage of the adsorption characteristics of the former. Three kinds of impregnated carbon such as TEDA + KI, Dimethyl iodide of TEDA, and monomethyl iodide of TEDA were prepared and their feasibilities of being applied for a ESF filter system were discussed comparing their physical and adsorption characteristics.

44744 (NUREG/CP–0098-Vol.1, pp. 619-626) **Active charcoal filter ignition tests.** Mori, A. (Pisa Univ. (Italy)); Pieve, L.; Rossi, G. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

Activated charcoal filters have wide applicability for gas adsorption system in nuclear or conventional plants. Such filters, where used for radioactive gas delay, may undergo some ignition risk due to decay heat and/or to self combustion process. A test system was set up to find out correlation between ignition point and charcoal physical parameters such as mean and bulk density, dynamic adsorption coefficient, surface area. This test system was realized in conformity with ANSI/ASTM D 3466 and the charcoal to test was prepared according to ANSI/ASTM D 2854 and in conformity with recommended Practice E 300. This paper reports experimental equipment, instruments and test procedure adopted along with an analysis of the data abbined. Results of the limits of these correlation and their applicability area are indicated.

44745 (NUREG/CP–0098-Vol.2, pp. 805-813) **Development of the airborne radioactivity effluent monitoring system for the waste isolation pilot plant.** Shenk, K.J. (Westinghouse Electric Corporation, Carlsbad, NM (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The unique aerosol characteristics present at the Waste Isolation Pilot Plant (WIPP) necessitated the development of an effluent monitoring system with the ability to operate under prevalent conditions. As a repository for the transuranic (TRU) wastes that have been generated from United States defense activities, the WIPP is being excavated approximately 655 m below the surface in a bedded salt deposit. The application of the monitoring problem at WIPP involves the measurement of airborne plutonium in a heavily laden salt dust environment at high flow rates. Operating conditions anticipated to exist at the WIPP are mass concentrations ranging from 300 $\mu g/m^3$ to 50 mg/m^3; and the volume of air to be exchanged by the ventilation system will vary between 33 m^3/s and 200 m^3/s. This paper provides an overview of the efforts involved in the design of the present effluent monitoring system at WIPP.

44746 (NUREG/CP–0098-Vol.2, pp. 834-846) **Continuous air sampling for radioactive aerosol.** McFarland, A.R. (Texas A & M Univ., College Station (USA)); Anand, N.K.; Ortiz, C.A.; Moore, M.E.; Kim, S.H.; DeOtte, R.E. Jr.; Somasundaram, S. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings*

of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15. Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The above-ground system for monitoring particle effluents from the underground pilot plant nuclear storage facility in Carlsbad, NM was considered inadequate by a State of New Mexico environmental review group. Subsequently, we were contracted to develop acceptable means for the sampling, transport and collection of aerosols from the mine ventilation air and from an exhaust stream that would be used in case of an emergency (presence of radioisotopes in the ventilation air). A new type of probe was developed for sampling aerosols with sizes $\leq$10 μm aerodynamic diameter from the exhaust streams. Particle losses in inclined aerosol transport tubes due to turbulent deposition and gravitational settling have been modeled and numerically analyzed. A special constraint is needed to solve for total deposition due to combined gravitation and turbulent effects. The results show that a unique optimal tube diameter exists for a given flow rate and particle size, and the optimum is independent of tube length. Aerosol tests were conducted with a continuous air monitor (CAM) sampler which was designed to monitor radioactive emissions and to provide an alarm if a release were to occur. At a flow rate of 2 cfm, the CAM sampler permitted on 24% of 10 μm aerosol particles to reach the filter, with the remainder being deposited on internal surfaces including the detector tube. We redesigned the flow system such that air enters the filter region radially from all directions. The penetration of 10 μm particles was increased to 86%.

44747 (NUREG/CP–0098-Vol.2, pp. 898-904) **Introduction of a new generation of high-capacity HEPA filters and a comparison of their performance to HEPA filters available on the market.** Allan, T.T. (Flanders Filters, Inc., Washington, NC (USA)); Singh, T.M. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

A recently developed manufacturing process has resulted in a high capacity hepa filter that meets the United States Department of Energy requirements. The DIMPLE-PLEAT™ process, using newly developed low resistance media formulation, has been successfully employed to produce a true separatorless glass microfiber filter element, SUPER-FLOW®, II" in any practical depth from 1 to 12 inches. A good number of 24" x 24" x 11 1/2" filters, after passing tests at the filter retest facility, have already been employed by a facility operated for the DOE. These filters are installed in a system designed for 2000 CFM per unit - a high capacity operation. In addition, these new filters are also routinely being supplied to other DOE operations. This specially formulated all glass microfiber nonwoven media is unique because it offers the lowest resistance and the highest dust holding capacity of any hepa filters meeting DOE requirements for strength and thickness as per MIL-F-51079D. Application of this media to an appropriate design for circular filters similar to those employed at Harwell (U.K.) is in progress.

44748 (NUREG/CP–0098-Vol.2, pp. 917-942) **Realization of commercial high strength HEPA filters.** Ruedinger, V. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.)); Ricketts, C.I.; Wilhelm, J.G. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

HEPA-filter media though having excellent particle removal efficiencies, remain characterized as rather brittle, fragile and weak materials. As a result, undesired structural damage followed by significant losses in filtration efficiency can easily occur in handling, transport, and even normal operation of filter units. In recent years extensive investigations into the structural limits of HEPA filters in dry air and under extended exposure to high humidity airflow have been carried out. In the course of this work the failure modes and the underlying failure mechanisms were thoroughly studied. On the basis of the information obtained, considerable improvements in the structural strength of HEPA filters could be achieved. As verified by removal efficiency tests, differential pressures up to 56kPa in dry air and 15kPa after extended operation under fog conditions were proven to be sustainable without mechanical damage to the filter medium. In cooperation with three major European filter manufacturers the know-how gained has been transferred into practical application through development of commercially available high-strength filter units. Three new KWU (Siemens-Kraftwerksunion) nuclear power plants in Germany have already been fully equipped with HEPA filters of this improved design. The German licensing authorities are now considering modifications of their requirement specifications to reflect the increased strength of the new filter units.

44749 (NUREG/CP–0098-Vol.2, pp. 984-993) **Prediction of HEPA filter pressure drop and removal efficiency during dust loading.** Letourneau, P. (Institut de Protection et de Surete Nucleaire, Gif-Sur-Yvette (France)); Mulcey, Ph.; Vendel, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The challenge of the HEPA filter is to predict the evolution of the pressure drop as a function of the conditions of filtration. The crucial factor in analyzing the service life of HEPA filters resides in determining the pressure drop and the efficiency as a function of the mass deposited on the filter. An experimental program has been developed to estimate the service life of a filter as a function of its clogging. The study was carried out on plane filters clogged with a fluorescein soda aerosol at different rates of filtration. A method of peeling was developed to determine the profile of particle deposit within the filter and to demonstrate its feasibility. Comparison between the experimental results and the clogging model developed by Bergman reveals a satisfactory correlation.

44750 (NUREG/CP–0098-Vol.2, pp. 997-1002) **Radioiodine testing of used nuclear grade activated carbon: Penetration results from samples tested with and without moisture equilibration according to a draft revision of ASTM D3803.** Freeman, W.P. (Nuclear Consulting Services, Inc., Columbus, OH (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Testing experience in our radioiodine laboratory has shown that used nuclear grade carbon samples tested according to ASTM D3830 Method A without the sixteen hour equilibration period (with 95% relative humidity air at 30°C) give consistently lower penetration values compared to the penetration values obtained with equilibration (required for testing new carbon). The results of the recent second NRC/INEL interlaboratory comparison confirmed our experience. Penetration results obtained using the non-equilibrated test method can thus provide misleading information regarding the quality of the carbon installed in nuclear air cleaning systems. Based on the above, a program was initiated to test used nuclear grade activated carbon samples from various utilities that had first been tested without equilibration. The test method followed was a draft revision of ASTM D3803 based essentially on the protocol developed during the second NRC/INEL interlaboratory comparison. This test requires sixteen hours of pre-equilibration followed by an additional two hours of equilibration. Additional tests were performed on samples generally tested at higher temperatures than 30°C, although usually equilibrated at the temperature and R.H. of the test. Results of the above testing program are discussed in terms of using the revised ASTM D3803 as the method of choice for judging the quality and performance of nuclear grade activated carbons.

44751 (NUREG/CP–0098-Vol.2, pp. 1016-1024) **Field test results of in-place charcoal adsorber leak-testing by pulse mode**

halide injection. Kovach, B.J. (Nuclear Consulting Services, Inc., Columbus, OH (USA)); Sommer, R.R. II; Banks, E.M. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Current recognized practices for adsorber in-place leak tests in the nuclear industry are by the use of intermittent sampling gas chromatographs, or by continuous sampling and continuous readout halide detectors. Both test methods normally utilize the continuous halide injection technique when testing to ANSI/ASME-N510, Testing of Nuclear Air-Cleaning Systems. The use of continuous reading halide detectors and pulse mode halide injection has made in-place leak testing of charcoal adsorber banks possible, where short halide delay times caused by high humidity and/or high airflow and where the release of contaminants from the adsorber surface interfere with data interpretation and subsequent test results. Interpretations of response curves from actual field measurements are given as examples, where leak test data acquired by previously described methods could not give a definite interpretation. The pulse mode halide injection method with continuous reading halide detection also provides additional information about available adsorbent surface sites and utilizes significantly less fluorocarbon, an already suggested practice.

44752 (NUREG/CP–0098-Vol.2, pp. 1055-1063) **Advanced filters for nuclear facilities and filter conditioning for disposal.** Jannakos, J. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.)); Potgeter, G.; Mock, H.; Furrer, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

This paper reports the advantages of the cylinder shape selected for the filter elements for aerosol and iodine removal from the offgas of nuclear facilities, above all in view of remote and manual operation and transport, conditioning and disposal. In order to test the conditioning of polygonal HEPA filter elements, several filter elements not exposed to radioactivity were crushed remotely and embedded in concrete in a 400 l waste drum. The waste drum was subsequently saw cut in order to verify the quality of concrete embedding. The result of concrete embedding is satisfactory. The design is presented of a filter element capable of accommodating gas flows up to 500 m^3/h for wet aerosol removal with a high removal efficiency. Also the design of a filter element for gas flows up to 800 m^3/h to be used in iodine removal from offgases with low iodine contents is described. In order to be able to use the cylindrical filter elements developed for remote handling in manual operation too, e.g., for cleaning low level offgases, a manually operated filter housing was developed. It is suited for working pressures up to 10 bar and working temperatures up to 160°C. The filter elements are replaced by the usual bagging technique.

44753 (NUREG/CP–0098-Vol.2, pp. 1064-1079) **Interim evaluation of the thermal stability of $Cu_{0.67}Y_{0.25}Kr_{0.08}$ sputter deposits.** McClanahan, E.D. (Pacific Northwest Laboratory, Richland, WA (USA)); Bradley, E.R. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Pacific Northwest Laboratory (PNL) has developed and demonstrated a pilot process for trapping and storing ^{85}Kr recovered and purified from the dissolver off-gas stream of a nuclear fuel reprocessing plant. Ions produced in a low-pressure krypton discharge are implanted in a growing sputtered film of $Cu_{0.67}Y_{0.25}Kr_{0.08}$ deposited on the inner wall of a krypton trapping storage device (KTSD). A main objective of this work is to measure the release of ^{85}Kr implanted in a copper-yttrium alloy. Release rates were obtained from periodic measurements of the krypton released from both radioactive and nonradioactive krypton-loaded KTSDs. In addition, the release rates from these specimens, and the thermal stability, using differential scanning calorimetry and thermogravimetric analysis, were compared with those of other alloys tested earlier. The overall release characteristics of the deposits are quite favorable for long-term storage. Both the radioactive and nonradioactive test specimens stored at temperatures not exceeding 350°C have shown that the release rates measured to date are $<0.1\%\ yr^{-1}$. The release rates for the radioactive specimens were obtained for storage periods of 2.2, 1.6, and 1.6 yr for 150, 250 and 350°C storage temperatures, respectively. The nonradioactive specimen has been held at temperatures ranging between 180 and 450°C, but mainly at 350°C, for a total storage time of 2.5 yr. Following the ~10-yr monitoring period, the remaining Cu-Y-^{85}Kr waste form should be evaluated to better predict overall stability for the full storage period.

44754 (NUREG/CP–0098-Vol.2, pp. 1130-1136) **Development of a high-efficiency, high-performance air filter medium.** Bergman, W. (Lawrence Livermore National Laboratory, CA (USA)); Sawyer, S.R. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. DOE Contract W-7405-ENG-48. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

A unique high-efficiency particulate air (HEPA) filter medium has been developed for applications in high temperature and high pressure environments. This filter medium is a composite made from quartz and stainless-steel fibers that have been sintered together. The composite medium has the same efficiency and pressure drop as standard HEPA glass media, but has four times the tensile strength and can operate continuously at temperatures up to 500°C. In a conventional HEPA, the binder burns out above 250°C and the medium loses its strength; our composite filter medium has no comparable loss of strength even at 500°C.

44755 (NUREG/CP–0098-Vol.2, pp. 1189-1209) **New filter efficiency test for future nuclear grade HEPA filters.** Bergman, W. (Lawrence Livermore National Laboratory, CA (USA)); Foiles, L.; Mariner, C. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. DOE Contract W-7405-ENG-48. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

We have developed a new test procedure for evaluating filter penetrations as low as 10^{-9} at 0.1-μm particle diameter. In comparison, the present US nuclear filter certification test has a lower penetration limit of 10^{-5}. Our new test procedure is unique not only in its much higher sensitivity, but also in avoiding the undesirable effect of clogging the filter. Our new test procedure consists of a two-step process: (1) We challenge the test filter with a very high concentration of heterodisperse aerosol for a short time while passing all or a significant portion of the filtered exhaust into an inflatable bag; (2) We then measure the aerosol concentration in the bag using a new laser particle counter sensitive to 0.07-μm diameter. The ratio of particle concentration in the bag to the concentration challenging the filter gives the filter penetration as a function of particle diameter. The bag functions as a particle accumulator for subsequent analysis to minimize the filter exposure time. We have studied the particle losses in the bag over time and find that they are negligible when the measurements are taken within one hour. We also compared filter penetration measurements taken in the conventional direct-sampling method with the indirect bag-sampling method and found excellent agreement.

44756 (NUREG/CP–0098-Vol.2, pp. 1210-1215) **Methods of testing HEPA filters with short upstream approaches.** Kirk, G.Q.

(Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)); Childress, C.E.; Schmoyer, D.D. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The design of an air cleaning system to be used in a high gamma radiation field presented unique problems for in-place Dioctyl phthalate (DOP) leak testing. The design required remotely changeable HEPA (High Efficiency Particulate Air) filters in a disposable, stainless steel housing, located underground in a stainless steel-lined concrete pit. The conventional approach of providing ten duct diameters of upstream mixing for the dispersion of the challenge aerosol was not a viable solution to the necessity of testing the second filter stage in the system. To establish aerosol (DOP) injection ports that could provide mixing in accordance with ANSI N510-80, a full-scale housing was built. The housing and components were built of Plexiglas to view the DOP streams. A series of tests was designed in which the following factors were varied: (1) aerosol distributors, (2) aerosol distributor locations, (3) baffle design, and (4) baffle location. DOP concentration measurements were taken immediately upstream of the filters. The uniformity score, as determined by ANSI N510-80, was defined as the larger of maximum minus average values of DOP concentration. Three tests met the uniformity score requirement of 0.20, but all three had ten duct diameters of upstream mixing. The type of aerosol distributor, duct length, and flow rate were found to most affect the uniformity score.

44757 (NUREG/CP–0098-Vol.2, pp. 1216-1230) **Development of filter systems injection systems and mixing device evaluation.** Loughborough, D. (United Kingdom Atomic Energy Authority, Oxfordshire (England)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

A problem when in-situ testing High Efficiency Particulate Air (HEPA) filters is to ensure that the test aerosol provides a uniform challenge to the whole of the filter face. Uniform challenge is defined in this case as a concentration variation of aerosol across the plane of the duct of less than +/- 10%. Injecting into an open duct via a single point injector requires a minimum of 30 hydraulic duct diameters (De) between the injector and sample point to ensure a mixed flow. This may be reduced to 10De with the use of a Stairmand disc mixer. Methods of reducing the lengths of ducting required for an in-situ filter test have been investigated. Results shows that there is a minimum aerosol exit velocity below which the mixing length requirement may be substantially increased. By ensuring that this minimum velocity is exceeded, Harwell has developed a system of multiple point injectors in conjunction with a modified Stairmand disc which reduces the mixing length to 5.5De. Further work has investigated two plane devices which reduce the lengths of ducting to 4.0De, although these have an associated increased resistance to airflow.

44758 (NUREG/CR–4918-Vol.3) **Control of water infiltration into near surface LLW [low-level radioactive waste] disposal units: Progress report.** Shulz, R.K.; Ridky, R.W.; O'Donnell, E. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; California Univ., Berkeley, CA (USA); Maryland Univ., College Park, MD (USA). Aug 1989. 21p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO - OSTI.

Water infiltration to buried waste is the prime problem of concern in designing waste disposal units for the humid areas. Conventional compacted clay layers (resistance layer barriers) have been subject to failure by subsidence and by permeability increases bought about by plant roots. A clay barrier with a rock cover without plants is being investigated. Also a combination of a resistive layer overlying a conductive layer is being investigated. Laboratory studies indicate that this approach can be very effective and field evaluations are underway. However, it must be noted that subsidence will negate the effectiveness of any buried layer barriers. A surface barrier (bioengineering management) has been evaluated in the field and found to be very effective in preventing water entry into waste disposal units. This surface barrier is easily repairable if damaged by subsidence and could be the system of choice under active subsidence conditions. 5 refs., 20 figs.

44759 (NUREG/CR–5367) **Comparison of strongly heat-driven flow codes for unsaturated media.** Updegraff, C.D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Sandia National Labs., Albuquerque, NM (USA); GRAM, Inc., Albuquerque, NM (USA). Aug 1989. 102p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-7145). Available from NTIS, PC A06/MF A01 - GPO - OSTI.

Under the sponsorship of the US Nuclear Regulatory Commission, Sandia National Laboratories (SNL) is developing a performance assessment methodology for the analysis of long-term disposal of high-level radioactive waste (HLW) in unsaturated welded tuff. As part of this effort, SNL evaluated existing strongly heat-driven flow computer codes for simulating ground-water flow in unsaturated media. The three codes tested, NORIA, PETROS, and TOUGH, were compared against a suite of problems for which analytical and numerical solutions or experimental results exist. The problems were selected to test the abilities of the codes to simulate situations ranging from simple, uncoupled processes, such as two-phase flow or heat transfer, to fully coupled processes, such as vaporization caused by high temperatures. In general, all three codes were found to be difficult to use because of (1) built-in time stepping criteria, (2) the treatment of boundary conditions, and (3) handling of evaporation/condensation problems. A drawback of the study was that adequate problems related to expected repository conditions were not available in the literature. Nevertheless, the results of this study suggest the need for thorough investigations of the impact of heat on the flow field in the vicinity of an unsaturated HLW repository. Recommendations are to develop a new flow code combining the best features of these three codes and eliminating the worst ones. 19 refs., 49 figs.

44760 (NUREG/CR–5426) **Examination of the use of continuum versus discontinuum models for design and performance assessment for the Yucca Mountain site.** Board, M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of High-Level Waste Management; Itasca Consulting Group, Inc., Minneapolis, MN (USA). Aug 1989. 70p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A05/MF A01 - GPO; OSTI; INIS.

This report examines the use of continuum and discontinuum numerical methods for analysis of the thermomechanical response of the rock mass at Yucca Mountain. Continuum numerical methods consider the rock to be a solid, unfractured body, whereas the discontinuum method is formulated specifically to account for the effects of discrete fractures. The fractures within the rock introduce overall non-linear material response due to slip and separation of rock blocks. Continuum models attempt to simulate this response through the use of non-linear constitutive laws. Discontinuum methods attempt to simulate the true response of the rock mass by correctly modeling the behavior of the joints as well as the deformability of the intact rock blocks. It is shown that, as the joint spacing, s, becomes small with respect to the size of the excavations, the behavior of the jointed rock approaches that of a solid with a form of elasto-plastic constitutive behavior. It is concluded that a continuum model with a form of "ubiquitous" or "compliant joint" plasticity law is probably sufficient for analysis of the thermomechanical response of excavations in welded tuff. However, one of the questions concerning Yucca Mountain which remains is the effect of fault structures on the stability performance of the repository, particularly under thermal and dynamic loads. Here, a true discontinuum approach seems necessary. 45 refs., 42 figs., 4 tabs.

44761 (ORNL/Sub–89-SC924/2) **Environmental monitoring six month report for the Tumulus Disposal Demonstration Project: Mid-fiscal year 1989.** Yager, R.E.; Furnari, J.A.; Craig, P.M. Oak Ridge National Lab., TN (USA); Environmental Consulting Engineers, Inc., Knoxville, TN (USA). May 1989. 65p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE89015663/JAW. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

The Fiscal Year 1989 Six Month Report is the fourth in a series of semi-annual Tumulus Disposal Demonstration Project (TDDP) data summary reports. This data summary spans the time from start of operations in June 1987 through the end of March 1989 with particular emphasis on the last six months: October 1988 through March 1989. The environmental data collected include run-off water quality and quantity, groundwater quality and levels, soil sampling and hydrometeorological data. These data are being used and analyzed here to demonstrate the environmental performance objectives for the TDDP as part of the overall performance assessment. Comparisons are made between pre- and post-operational data and data collected during size month period ending March 31, 1989. No significant environmental impacts have been found since operations have begun. 13 refs., 28 figs., 12 tabs.

44762 (ORNL/TM–10906) **Development of immobilization technology for Hanford Double-Shell Slurry Feed waste.** Tallent, O.K.; McDaniel, E.W.; Del Cul, G.D.; Dodson, K.E.; Trotter, D.R. Oak Ridge National Lab., TN (USA). Aug 1989. 53p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE89015652/JAW. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

The leachabilities of technetium and nitrate wastes immobilized in cement-based materials (i.e., grouts) have been investigated using ANS – 16.1 test procedures. Factors found to affect the leachabilities include grout/mix ratio, grout fluid density, dry/solid blends (including ground blast-furnace slag), and waste concentration. 10 refs., 7 figs., 30 tabs.

44763 (ORNL/TM–10940) **Assessment of thermal analysis software for the DOE Office of Civilian Radioactive Waste Management.** Williams, P.T.; Graham, R.F.; Lagerberg, G.N.; Chung, T.C. Oak Ridge National Lab., TN (USA). Jul 1989. 89p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. Order Number DE89015651/JAW. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

This assessment uses several recent assessments and the more general code compilations that have been completed to produce a list of 116 codes that can be used for thermal analysis. This list is then compared with criteria prepared especially for the Department of Energy Office of Civilian Radioactive Waste Management (DOE/OCRWM). Based on these criteria, fifteen codes are narrowed to three primary codes and four secondary codes for use by the OCRWM thermal analyst. The analyst is cautioned that since no single code is sufficient for all applications, a code must be selected based upon the predominate heat transfer mode of the problem to be solved, but the codes suggested in this report have been used successfully for a range of OCRWM applications. The report concludes with a series of recommendations for additional work of which the major points include the following: The codes suggested by this report must be benchmarked with the existing US and international problems and validated when possible; An interactive code selection tool could be developed or, perhaps even more useful, a users group could be supported to ensure the proper selection of thermal codes and dissemination of information on the latest version; The status of the 116 codes identified by this report should be verified, and methods for maintaining the still active codes must be established; and special capabilities of each code in phase change, convection and radiation should be improved to better enable the thermal analyst to model OCRWM applications. 37 refs., 3 figs., 12 tabs.

44764 (PNL–6906-Vol.2) **Spent fuel assembly hardware: Characterization and 10 CFR 61 classification for waste disposal: Volume 2, Calculated activity profiles of spent nuclear fuel assembly hardware for pressurized water reactors.** Short, S.M.; Luksic, A.T.; Lotz, T.L.; Schutz, M.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 134p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. Order Number DE89015191/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Consolidation of spent fuel is under active consideration as the US Department of Energy plans to dispose of spent fuel as required by the Nuclear Waste Policy Act of 1982. During consolidation, the fuel pins are removed from an intact fuel assembly and repackaged into a more compact configuration. After repackaging, approximately 30 kg of residual spent fuel assembly hardware per assembly remains that is also radioactive and requires disposal. Understanding the nature of this secondary waste stream is critical to designing a system that will properly handle, package, store, and dispose of the waste. This report present a methodology for estimating the radionuclide inventory in irradiated spent fuel hardware. Ratios are developed that allow the use of ORIGEN2 computer code calculations to be applied to regions that are outside the fueled region. The ratios are based on the analysis of samples of irradiated hardware from spent fuel assemblies. The results of this research are presented in three volumes. In Volume 1, the development of scaling factors that can be used with ORIGEN2 calculations to estimate activation of spent fuel assembly hardware is documented. The results from Laboratory analysis of irradiated spent-fuel hardware samples are also presented in Volume 1. In Volumes 2 and 3, the calculated flux profiles of spent nuclear fuel assemblies are presented for pressurized water reactors and boiling water reactors, respectively. The results presented in Volumes 2 and 3 were used to develop the scaling factors documented in Volume 1.

44765 (PNL–6906-Vol.3) **Spent fuel assembly hardware: Characterization and 10 CFR 61 classification for waste disposal: Volume 3, Calculated activity profiles of spent nuclear fuel assembly hardware for boiling water reactors.** Short, S.M.; Luksic, A.T.; Schutz, M.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 164p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC06-76RL01830. Order Number DE89015189/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

Consolidation of spent fuel is under active consideration as the US Department of Energy plans to dispose of spent fuel as required by the Nuclear Waste Policy Act of 1982. During consolidation, the fuel pins are removed from an intact fuel assembly and repackaged into a more compact configuration. After repackaging, approximately 30 kg of residual spent fuel assembly hardware per assembly that is also radioactive and required disposal. Understanding the nature of this secondary waste stream is critical to designing a system that will properly handle, package, store, and dispose of the waste. This report presents a methodology for estimating the radionuclide inventory in irradiated spent fuel hardware. Ratios are developed that allow the use of ORIGEN2 computer code calculations to be applied to regions that are outside the fueled region. The ratios are based on the analysis of samples of irradiated hardware from spent fuel assemblies. The results of this research are presented in three volumes. In Volume 1, the development of scaling factors that can be used with ORIGEN2 calculations to estimate activation of spent fuel assembly hardware is documented. The results from laboratory analysis of irradiated spent-fuel hardware samples are also presented in Volume 1. In Volume 2 and 3, the calculated flux profiles of spent nuclear fuel assemblies are presented for pressurized water reactors and boiling water reactors, respectively. The results presented in Volumes 2 and 3 were used to develop the scaling factors documented in Volume 1.

44766 (REG/G–3.48-Rev.1) **Standard format and content for the safety analysis report for an independent spent fuel storage installation or monitored retrievable storage installation (dry storage): Revision 1, Task CE 406-4.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Aug 1989. 84p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A05/MF A01 - GPO - OSTI.

Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste," of Title 10 of the Code of Federal Regulations specifies the information to be supplied in applications for licenses to store spent fuel in an independent spent fuel storage installation (ISFSI) or to store spent fuel and high-level radioactive waste in a monitored retrievable storage (MRS) installation. However, Part 72 does not specify the format for presentation of the safety analysis report (SAR). Guidance on the content of the SAR will vary, depending on the type of installation that is planned. This guide represents a Standard Format that is acceptable to the NRC staff for the SAR required for the license application. Conformance with this Standard Format, however, is not mandatory. License applications with differing SAF formats will be

acceptable to the staff if they provide an adequate basis for the findings required for the issuance of a license.

44767 (SAND–86-1054) **Feasibility Study: Applicability of geochronologic methods involving radiocarbon and other nuclides to the groundwater hydrology of the Rustler Formation, southeastern New Mexico.** Lambert, S.J. Sandia National Labs., Albuquerque, NM (USA). Dec 1987. 72p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89016927/JAW. Available from NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.

Radiocarbon, tritium, and ^{36}Cl were measured in groundwaters from the dolomite aquifers of the Rustler Formation in the northern Delaware Basin of southeastern New Mexico to determine the feasibility of using these nuclides in dating the groundwater at and near the Waste Isolation Pilot Plant, a facility for geological disposal of Radioactive waste. No measurable ^{36}Cl was found in any of these groundwaters, which derive their dissolved chloride from Permian evaporites. Demonstrably uncontaminated groundwaters contained no significant amounts of tritium (<0.2 TU). Percent modern carbon (PMC) correlates linearly and directly with bicarbonate concentration, indicating mixing of a high-PMC/high-bicarbonate reservoir with a low-PMC/low-bicarbonate reservoir. This relationship together with the history of development of the wells sampling the groundwaters, indicates contamination by anthropogenic modern carbon rather than simple dilution by dissolving rock carbonate. $\delta^{13}C$ does not linearly correlate with bicarbonate, indicating no single source of contaminant radiocarbon. Values of PMC and $\delta^{13}C$ for groundwaters were used to calculate apparent radiocarbon ages according to an interpretive model that accounts for water/rock interactions in carbonate aquifers. All but six pairs of values give significant negative ages (−1,000 to −7,000 years). This suggests that in contaminated samples the model over-adjusts (based on $\delta^{13}C$) for radiocarbon loss due to dilution and isotopic exchange with the rock. 52 refs., 10 figs., 6 tabs.

44768 (UCID–21600) **Repository Technology Program activities, FY 1988.** Yow, J.L. Jr.; Wijesinghe, A.M.; Thorpe, R.K.; Knapp, R.B. Lawrence Livermore National Lab., CA (USA). Jul 1989. 28p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-7405-ENG-48. Order Number DE89015187/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Our technical activities in FY 1988 included instrument selection and evaluation, calculational work, and simulator development. Near the end of the fiscal year, we began preparing several topical reports to document our results. This fiscal year, we continued developing three-dimensional numerical simulators to model coupled hydrologic-and mechanical-rock mass responses and, thus, to provide representative numerical tools for understanding and calculating these in situ processes. We also began scoping calculations in the second half of FY 1988 to evaluate ERE design criteria, but this work was redirected late in the year when the DOE/AECL Subsidiary Agreement was set aside. Our work in developing and evaluating experimental techniques focused on total pressure measurements, moisture content measurement, and tracer detection instrumentation for sealing experiments and for rock-mass-response field tests. At the end of the fiscal year, we completed a review of measurement technology for instrumenting migration/sorption tests to help define the technological requirements in these areas. By the end of FY 1988, we had completed a review of the existing codes for simulating reactive transport; we are using the results of this review to help formulate plans for future activities in this area. The following sections describe the major RTP tasks and activities at LLNL in more detail, and they include our FY 1988 accomplishments in these areas. 8 refs., 22 figs.

44769 (WHC-EP–0141-1) **Westinghouse Hanford Company effluent discharges and solid waste management report for calendar year 1988: 200/600 Areas.** Coony, F.M.; Thomas, S.P. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 234p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015818/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This report presents calendar year 1988 radiological and nonradiological effluent discharge data from facilities in the 200 Areas and the 600 Area of the Hanford Site. Both summary and detailed effluent data are presented. In addition, radioactive and nonradioactive solid waste storage and disposal data for calendar year 1988 are furnished. Where appropriate, comparisons to previous year are made. The intent of the report is to demonstrate compliance of Westinghouse Hanford Company-operated facilities with administrative control limits for radioactive constituents and applicable guidelines and standards (including Federal permit limits) for nonradioactive constituents.

44770 (WHC-MR–0033) **Recharge to the North Richland well field.** Law, A.G. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 21p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-87RL10930. Order Number DE89016120/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The investigation was based on a preliminary ground-water flow model of the 1100 Area. Because few local data were available for this effort, an existing regional ground-water flow model of the Hanford Site was applied, which is based on the Variable Thickness Transient (VTT) ground-water flow code (Kipp et al., 1976). A submodel of the Hanford Site model was developed based on the VTT code. An independent model consisting of a simple representation of the local conditions in the vicinity of the North Richland well field was also used in the investigation. This model, based on the MODFLOW code (McDonald and Harbaugh, 1984), was used in a series of transient simulations to examine dynamic aspects of the well field/recharge basin. Results from this simple model also provide an independent, qualitative check of results produced with the 1100 Area model based on the VTT code. This report summarizes the 1100 Area modeling investigation, including the approach used to generate results for the regional and 1100 Area VTT models, the approach used in the transient MODFLOW model, results from some initial steady-state and transient simulations with the submodel and the MODFLOW models, and resulting conclusions and recommendations. Because local data were lacking to develop and calibrate the models, the investigation described in this report can best be described as a "sensitivity analysis" of ground-water flow in the 1100 Area. 4 refs., 10 figs., 2 tabs.

44771 (WHC-SA–0367) **Demonstration of technologies to remove contamination from groundwater.** Hodgson, K.M.; Garrett, L. Westinghouse Hanford Co., Richland, WA (USA). Mar 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890927–1: 3. international conference on new frontiers for hazardous waste management, 10-13 Sep 1989). Order Number DE89013534/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Westinghouse Hanford Company has been testing various technologies for decontaminating groundwaters and liquid effluents. The results of preliminary testing of three technologies are reported. The technologies are iron coprecipitation/filtration, supported liquid membranes, and reverse osmosis. The processes were tested to determine their capability to remove uranium, chromium, nitrates, and technetium. All processes removed contaminants to less than maximum contaminant limits. The secondary waste volumes were estimated for each process. The supported liquid membranes secondary waste volume was the smallest, followed by iron coprecipitation, and the largest volume was created by the reverse osmosis process. 5 refs., 7 tabs.

44772 (WHC-SA–0493) **Quantitative diffuse reflectance infrared fourier transform spectrometric studies of cementitious blends.** Rebagay, T.V.; Dodd, D.A. Westinghouse Hanford Co., Richland, WA (USA). Jul 1989. 25p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890760–1: 31. Rocky Mountain conference on analytical chemistry, 30 Jul - 4 aug 1989). Order Number DE89016053/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The effective immobilization of low-level radioactive liquid wastes in the form of grout depends on the quality of the dry cementitious blends used in the grout formulation. Variation in the mix ratios of the components of the blend can cause detrimental effects on the processing behavior of the grout slurry and the final properties of the cured grout. Thus the blends require thorough chemical characterization and monitoring by strict quality control protocols. In an

earlier work at our laboratories, Fourier transform infrared- transmission method has been successfully applied in the analysis of blends of cement, fly ash, and clays. However, this method involved time-consuming sample preparation resulting in slow turnaround for repetitive sampling. A practical approach to quality control required a fast and simple method for the analysis of the blends. This paper describes a diffuse reflectance infrared Fourier transform (DRIFT) spectrometric procedure for the routine examination of neat blends consisting of cement, fly ash, clays and/or blast furnace slags. (1 ref., 10 figs., 4 tabs.)

44773 (WHC-SA–0571) **Nonlinear seismic analysis of a thick-walled concrete canyon structure.** Winkel, B.V. Westinghouse Hanford Co., Richland, WA (USA). Mar 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890993–1: 6. conference on computing in civil engineering, 11-13 Sep 1989). Order Number DE89010107/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Conventional linear seismic analyses of a thick-walled lightly reinforced concrete structure were found to grossly underestimate its seismic capacity. Reasonable estimates of the seismic capacity were obtained by performing approximate nonlinear spectrum analyses along with static collapse evaluations. A nonlinear time history analysis is planned as the final verification of seismic adequacy. 5 refs., 4 figs.

44774 (WHC-SA–0598) **Liquid-fed ceramic melter testing for the Hanford Waste Vitrification Plant waste.** Perez, J.M. Jr.; Goles, R.W.; Nakaoka, R.K.; Sevingy, G.J.; Larson, D.E.; Kruger, O.L. Westinghouse Hanford Co., Richland, WA (USA). Apr 1989. 23p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-890488–10: 4. international symposium on ceramics in nuclear waste management, 23-27 Apr 1989). Order Number DE89015577/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The HWVP Project is proceeding aggressively on simultaneous design and development paths. The major development goals are intended to support design and process definition, waste form qualification, and site and permitting activities. In achieving these goals the HLW glass producer shares many of the challenges of the commercial glass industry. A reliable feedstream with consistent composition and physical properties is required to maximize throughput. The prevention of secondary phases such as spinels, insoluble alkali salts, and reduced metals is crucial to maintain a high on-stream factor and long melter life. The treatment of process off gases to maximize process recycle and eliminate environmentally harmful gases and particulate matter is a necessity. Finally, by thoroughly understanding the process and its control, a high-quality glass can be produced that will meet disposal requirements. This paper focuses on liquid-fed, ceramic-lined melter and off-gas treatment equipment testing to date. Following the process description and related testing requirements, the results of melter testing are presented with emphasis on FY 1988 test results. 4 refs., 5 figs., 6 tabs.

44775 (WHC-SA–0624) **Quality assurance for the Hanford Waste Vitrification Plant project.** Caplinger, W.H. Westinghouse Hanford Co., Richland, WA (USA). Jun 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. (CONF-8909110–5: 16. annual conference of the American Society for Quality Control, 17-20 Sep 1989). Order Number DE89016548/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The current quality assurance emphasis is to identify the specific evolution points in the various project activities where OGR/B-14 must be applied to ensure that the end product meets the OGR/B-8 requirements. These will be identified initially in the Waste Compliance Plan based on criteria in the Quality Assurance Program Description for HWVP. The Defense Waste Processing Facility (DWPF) at Savannah River is currently involved in the same task, and there is considerable collaboration. This paper presents the interim status of the quality assurance requirements and their implementation. Brief descriptions of the mission, facility, and organizations are also presented. 8 refs., 1 fig.

44776 (WHC-SP–0428) **Fiscal year 1989 Defense Waste Management and Environmental Program Plan.** Westinghouse Hanford Co., Richland, WA (USA). Nov 1988. 200p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89016340/JAW. Available from NTIS, PC A09/MF A01 - OSTI; GPO Dep.

The fiscal year (FY) 1989 Defense waste Management and Environmental Program Plan provides a summary baseline for end function schedules, major milestones, budges, and Work Breakdown Structure through FY-1995. The formal of this Program has been revised to focus on key program elements. All schedule and budget information has been summarized in a fashion to help the reader better understand the program activities, goals, and integration points. Detailed building block charts have been deleted to eliminate confusion on program priorities. In addition to the baseline information, the Defense Waste Management and Environmental program's missions, objectives, strategies, and near-term work activities are described.

44777 **Overview of the prototypical rod consolidation program.** Clark, J.H.; Maughan, R.Y. *Transactions of the American Nuclear Society (USA),* 57: 324-325 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The prime objective of this project is to develop a spent nuclear fuel rod consolidation system that is capable of consolidating 750 tonne HM/yr during an operating cycle of two shifts per day, 5 days per week. This system is to be remotely operable and maintainable and have a reliability equal to or greater than 75%. The space envelope at a future facility specified for this equipment is 6.1 m (20 ft) wide x 16.8 m (55 ft) long x 10.2 m (33.5 ft) high. To accomplish the annual throughput (750 tonne HM), the consolidation equipment will have to process an average of ≈3000 fuel assemblies per year, which equates to handling in excess of 450,000 fuel rods per year. Remote handling and processing equipment challenges are identified and discussed in this paper for (a) efficient fuel assembly handling, (b) disassembly of the fuel assemblies, (c) extracting and control of the fuel rods during reconfiguration from the square array in the fuel assembly to a triangular array in a consolidated fuel rod canister, and (d) the accountability of the large number of fuel rods. This paper presents details of the NUS equipment designs and how each of these remote operations is addressed.

44778 **Vitrification process equipment design for the West Valley Demonstration Project.** Chapman, C.C.; Drosjack, W.P. *Transactions of the American Nuclear Society (USA),* 57: 338 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The vitrification process and equipment design is nearing completion for the West Valley Demonstration Project. This paper discusses the basis and current status of the design of major vessels and equipment within the West Valley vitrification plant along with an overview of the function and key design features. Remote technological advances incorporated in the equipment are emphasized. The major subsystems described include feed preparation and delivery, the melter, canister handling, and process off-gas. The remote design features of the equipment are highlighted.

44779 **Design and installation of a radioactive filter leaching system at the Idaho Chemical Processing Plant.** Waite, T.H. *Transactions of the American Nuclear Society (USA),* 57: 340-341 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

The operation of facilities at the Idaho Chemical Processing Plant (ICPP) of the Idaho National Engineering Laboratory involves handling radioactive, transuranic (TRU), hazardous materials and their mixtures. High-efficiency particulate air (HEPA) filters are used in the off-gas streams to prevent these materials from reaching the environment. Due to the increased cost and complexity of the disposal of these contaminated filters, a filter leaching system has been designed and installed at the New Waste Calcining Facility (NWCF), which is located at the ICPP. The filter leaching system uses heated nitric acid and an air sparge to remove TRU and hazardous materials from the filters to that only trace quantities remain. The radiation fields are also reduced sufficiently to allow the filters to be disposed of with reduced shielding requirements. This results in a significant cost savings and makes handling and disposal of the used filters easier.

44780 WIPP welder for remotely handled transuranic waste overpack. Lott, J.; Palanca, R.; Racki, D.J. *Transactions of the American Nuclear Society (USA),* 57: 342-343 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Remotely handled transuranic (RH TRU) waste packages arriving at the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, will be examined for surface radioactive contamination and visible damage in a hot cell prior to their transfer into the facility cask for transport and storage underground. Any waste package indicating damage or excessive surface contamination will be placed in a thin-walled, cylindrical, carbon steel container (overpack), and a lid welded to the container (overpack) using equipment located in the hot cell for this purpose. The overpacked waste package is then transported underground for emplacement. This paper describes the automatic, remotely operated welding system, which performs the overpack closure weld, including the supporting system's equipment and components.

44781 Overhead robot system for remote HEPA filter replacement. Wiesener, R.W. *Transactions of the American Nuclear Society (USA),* 57: 343-344 (1988). (CONF-881011--: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

A high-efficiency particulate air (HEPA) filter system for facility exhaust air filtraction of radioactive particles has been designed that utilizes a modified industrial gantry robot to remotely replace filter elements. The system filtration design capacity can be readily changed by increasing or decreasing the number of plenums, which only affects the cell length and robot bridge travel. The parallel flow plenum design incorporates remote HEPA filter housings, which are commercially available. Filter removal and replacement is accomplished with the robot under sequenced program control. A custom-designed robot control console, which interfaces with the standard gantry robot power center controller, minimizes operator training. Critical sequence steps are operator verified, using closed-circuit television (CCTV), before proceeding to the next programmed stop point. The robot can be operated in a teleoperator mode to perform unstructured maintenance tasks, such as replacing filter housing components and cell lights.

0530 Environmental Aspects

Refer also to citation(s) 44699, 44700, 44702, 44704, 44705, 44706, 44707, 44708, 44709, 44710, 44712, 44713, 44715, 44716, 44717, 44718, 44719, 44724, 44732, 44733, 44735, 44736, 44742, 44743, 44744, 44745, 44746, 44747, 44748, 44749, 44750, 44751, 44752, 44754, 44755, 44756, 44757, 44758, 44760, 44761, 44762, 44764, 44765, 44766, 44767, 44768, 44769, 44770, 44771, 44774, 44775, 44776, 44793, 44795, 44796, 44797, 44798, 44799, 44800, 44801, 44802, 44803, 44804, 44805, 44810, 45088, 45090, 45091, 45092, 45093, 45095, 45096, 45097, 45098, 45099, 45100, 45101, 45102, 45196, 45771, 46081, 46116, 46119, 46120, 46121, 46165, 46181, 46759

0540 Health and Safety

Refer also to citation(s) 44702, 44721, 44814, 44815, 44816, 45137, 45141, 46147

44782 (CONF-881054--Vol.2, pp. 369-373) **An overview of the Department of Energy defense programs environmental restoration program.** Lehr, J.C. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The Department of Energy (DOE) established the Environmental Restoration (ER) Program in 1987 to coordinate the remediation of Defense Programs (DP) inactive hazardous waste sites and to take corrective actions for any releases of hazardous wastes from any waste management unit meeting the definition of past disposal site. There are currently 16 DOE-DP installations involved in the ER Program. Within these facilities more than 3500 release sites have been identified. The final draft of the ER Program Management Plan (PMP) was prepared in early 1988. The PMP develops the systems and procedures for management draft of the ER and Implementation Plan (PIP). A Program Optimization System (POS) has been developed to assist in making value judgments for allocation of programmatic funds beginning FY 1990. In the coming fiscal year, the PIP and PMP will be updated, with the emphasis on documentation requirements and the implementation of DOE Order 4700.1. While the program has made progress, it has not yet sufficiently matured to provide credible long-term cost estimates or schedule baselines.

44783 (CONF-881054--Vol.2, pp. 375-384) **The Installation Restoration Program: Three years of experience in the Department of Defense CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) program.** Franco, P.J. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)); Porell, A.L. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The Hazardous Waste Remedial Actions Program (HAZWRAP) Support Contractor Office plays a major role in the Department of Defense (DOD) Installation Restoration Program (IRP). The IRP is DOD's program for identifying past disposal sites and for eliminating hazards to public health and the environment. Since 1986, HAZWRAP has conducted a variety of projects for the US Air Force and Navy at the request of the Department of Energy (DOE). This paper discusses HAZWRAP's involvement in the IRP, some of the lessons learned during the course of this relationship, and initiatives that are being taken to remove sites from the IRP. The DOE may have an interest in HAZWRAP's experiences with the IRP in planning for its equivalent program.

44784 (CONF-881054--Vol.2, pp. 397-407) **Interim covering of waste pit 4 at the feed materials production center.** Krauss, M.J. (Westinghouse Materials Co. of Ohio, Cincinnati (USA)). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The Feed Materials Production Center (FMPC) is a Department of Energy (DOE) owned facility operated by Westinghouse Materials Company of Ohio (WMCO) for the purpose of producing metallic uranium fuel elements, target cores, and other uranium compounds. These materials are used at other DOE facilities in support of the US defense program. In the past, disposal of waste generated from production operations at the FMPC was accomplished by constructing waste disposal pits and landfilling the waste. As a result of this practice, the FMPC has six waste disposal pits which contain many different types of waste including uranium, thorium, construction rubble, fly ash and various other wastes unique to the FMPC. None of the waste disposal pits are currently operated for the disposal of waste and all six pits are being investigated under a sitewide Remedial Investigation/Feasibility Study to determine what effect the pits are having on the environment. Waste Pit 4 is unique among the six pits in that it contains an amount of mixed (hazardous/radioactive) waste and has been classified under the Resource Conservation and Recovery Act as a hazardous waste landfill. For this reason the US Environmental Protection Agency requested that the US DOE consider interim closure of Waste Pit 4 to prevent surface water infiltration. To meet this request, WMCO developed the Cover for Pit 4 project which involves placing subgrade fill onto the existing pit surface to form a domed cap over the pit, covering the cap with 0.6 meters of clay compacted to 10^{-7} cm/sec permeability, and installing a 1.1 millimeter reinforced Hypalon cover over the clay. This paper will detail the design process with the associated problems and solutions and the projected construction sequence.

44785 (CONF-881054--Vol.2, pp. 483-494) **Quality control requirements of chemical analyses for the hazardous waste remedial action program.** Miller, M.S. (Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA)); Mencer, G.J.; Zolyniak, J.W. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference*

proceedings. Volume 2. Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

This paper describes the Quality Control (QC) requirements for sample collection, analysis, and data reporting in support of the Hazardous Waste Remedial Actions Program (HAZWRAP) Supporting Contractor Office. The requirements are to be used in support of remedial response activities, such as preliminary assessment, site inspection, remedial investigation, feasibility study, and remedial actions. The analysis of various matrices are required during each of the tasks, therefore, requiring specific analytical activities and sampling considerations. The QC activities are based on the Environmental Protection Agency (EPA) protocols. The sampling requirements include specified frequencies for trip, field, and rinsate blanks; and field duplicates. The sampling program also includes review of the work plan, sampling procedures, and audits of sample collection. The sampling requirements for documentation include chain-of-custody, instruments calibration, and usage logs, field sampling logs, and well and soil boring logs. The analytical requirements include a laboratory approval process which encompasses performance samples, review of site specific work plans, and laboratory audits. The QC program includes three levels. In the first level, full Contract Laboratory Protocols (CLPs) are used for analysis and data validation. In the second level, SW-846, CLP, and the EPA methods specified in the Methods for Chemical Analysis of Water and Wastes may be used. Third level requirements include calibration, with reduced deliverables, and data validation requirements.

44786 (CONF-881054–Vol.2, pp. 497-506) **How do you known when you have enough emergency preparedness?.** Debusk, R.E. (Westinghouse Materials Co. of Ohio, Cincinnati (USA)). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. DOE Contract AC05-86OR21600. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

US Department of Energy (DOE) emergency planners are faced with a difficult question. Do DOE facilities have adequate emergency preparedness programs? The question would be more easily answered if emergency managers could go to a central guidance document that specifies all areas of concern (procedures look like this, exercises are conducted like this, etc.). However, even if such a document did exist, it would not be sufficient to ensure that programs were effectively implemented. Professionals with the required training and experience are needed to interpret complex guidance and develop effective DOE facility-specific emergency preparedness programs. An increased emphasis on the professional development of DOE and contractor emergency planners is needed. The author must strengthen the professional competence of emergency planners so they can interpret standards and implement effective programs that address the complex hazards of each facility and the many and varied interests of the DOE, contractor management, unions, local governments, the media and special interest groups.

44787 (CONF-881054–Vol.2, pp. 519-528) **The computerized hypergolic emergency response protocol system (CHERPS).** Bilbo, T. (ICF Technology Inc., Fairfax, VA (USA)); Shaver, D.K.; Held, K. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

CHERPS (Computerized Hypergolic Emergency Response Protocol System) is a state-of-the-art, automated, decision support system that assists decision makers in structuring hazard control and mitigation techniques for responding to releases of hypergolic propellants. The system provides timely access to critical information concerning emergency response actions, location and availability of response equipment and materials, and existing and expected hazards. Information concerning the release source and conditions allows for the calculation and display of a preliminary toxic hazard corridor (THC) on digitized maps of the site and can be used to identify areas that may require evacuation. Hypergolic propellant characteristics and physical, chemical, and toxicological data are also accessible through an extensive data base. In addition, the CHERPS hazardous materials inventory module, once fully integrated, will provide the capability to satisfy hazardous materials reporting requirements specified in SARA Title III, as well as emergency response support for other hazardous materials. CHERPS also communicates site hazard information between groups responsible for managing, assisting, and responding to an emergency and is capable of importing data from external sources.

44788 (CONF-881054–Vol.2, pp. 529-536) **How to design safe drills and exercises.** Stovall, C.L. (Virginia Polytechnic Institute and State Univ., Blacksburg (USA)); McVey, T.L. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

This research paper describes techniques for planning safe drills and exercises. The authors have incorporated these techniques into a useful tool. This tool has been designed as a checklist to make the exercise designer's job easier. The checklist is divided into four phases: Inventory, Exercise Design, Exercise Implementation, and Exercise Evaluation.

44789 (CONF-881054–Vol.2, pp. 539-550) **Procedure for estimating facility decommissioning costs for non-fuel-cycle nuclear facilities.** Short, S.M. (Battelle Pacific Northwest Lab., Richland, WA (USA)). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The Nuclear Regulatory Commission (NRC) staff has been reappraising its regulatory position relative to the decommissioning of nuclear facilities over the last several years. Approximately 30 reports covering the technology, safety, and costs of decommissioning reference nuclear facilities have been published during this period in support of this effort. One of these reports, Technology, Safety, and Costs of Decommissioning Reference Non-Fuel-Cycle Nuclear Facilities (NUREG/CR-1754), was published in 1981 and was felt by the NRC staff to be outdated. The Pacific Northwest Laboratory (PNL) was asked by the NRC staff to revise the information provided in this report to reflect the latest information on decommissioning technology and costs and publish the results as an addendum to the previous report. During the course of this study, the NRC staff also asked that PNL provide a simplified procedure for estimating decommissioning costs of non-fuel-cycle nuclear facilities. The purpose being to provide NRC staff with the means to easily generate their own estimate of decommissioning costs for a given facility for comparison against a licensee's submittal. This report presents the procedure developed for use by NRC staff.

44790 (CONF-881054–Vol.2, pp. 551-562) **Decommissioning at Sellafield.** Colquhoun, A. (British Nuclear Fuels plc, Risley). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The background to the initial Ten Year Plan for Sellafield is outlined and the decommissioning process for fuel cycle facilities described and factors influencing the choice and timing of its stages indicated. The parallel ten year program of development work is outlined and some lead projects and associated development aspects highlighted.

44791 (CONF-881054–Vol.2, pp. 611-619) **Corrective action investigation of a mixed waste contaminated percolation pond.** Van Deusen, L.C. (EG and G Idaho, Inc., Idaho Falls (USA)); Monnot, D.R.; Hull, L.C.; Davis, K.D.; Weiler, F.H.; Sheldon, D.E. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. DOE Contract AC07-76ID01570. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

The Idaho National Engineering Laboratory (INEL), located in southeast Idaho and operated by the Department of Energy (DOE),

has had the largest number of nuclear reactors during its lifetime of any location in the US. The Test Reactor Area (TRA), one facility within the INEL, has been the home of three major test reactors, one of which is still operational. The TRA Warm Waste Pond is a three-celled percolation pond that has received waste water from these reactor operations since 1952. The pond is estimated to have received over 27,700 lbs of chromium in addition to about 5.2×10^4 curies of radioactive materials. Because of known migration of contaminants to a perched-water zone, the pond is scheduled for corrective actions under a Resource Conservation and Recovery Act (RCRA) Consent Order and Compliance Agreement with Region X, Environmental Protection Agency (EPA). The pond will probably be included on the National Priority List by the spring of 1989. Field investigations were initiated in 1987 and continued in 1988 to pursue possible corrective or remedial actions. This paper describes the effort to date, including a description of the unique problems and physical restrictions associated with sampling the pond while it is in use and sampling through the gravel and cobblestones that line the pond.

44792 (CONF-881054–Vol.2, pp. 649-660) **Public interface and waste management planning: An approach for integrating community involvement in waste strategies.** Xiques, P.J. (Science Applications International Corp. (USA)). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

Public involvement and information programs have bridged a communication abyss and allowed waste management policymakers to understand legitimate public concerns. The perception often held by waste generators that technical concerns had greater validity than institutional issues is being altered as managers realize that information failures can halt a program as abruptly as technical ones. The role and level of involvement of the public in establishing waste management policies has changed dramatically over the past decade. Once the domain only of the generators and regulators, effective waste management strategy development must now make early provisions for public and local government involvement. By allowing public decision makers to participate in the initial planning process and maintain involvement throughout the implementation, many institutional barriers can be avoided. In today's climate, such barriers may represent direct costs, such as litigation, or indirect costs, such as delay, deferral, or duplication of work. Government programs have historically enjoyed a degree of insulation from public involvement factors on the basis of national security, defense, or the greater public good. However, such programs are no longer sacrosanct. Today, the cost of cleaning up past environmental impact can leave little or no money to meet present program objectives. Thus failure to get a public consensus before beginning remedial action can have a major impact on the allocation of scarce resources. Specific approaches to integrating the public into the planning phase of waste management will be addressed, including audience identification, issue analysis and tracking, prioritization of concerns, and information tool development.

44793 (CONF-8810239–Absts., pp. 2.103) **NEPA/CERCLA compliance at the Weldon Spring Site Remedial Action Project (WSSRAP).** McCracken, S. (Dept. of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The Weldon Spring Site Remedial Action Project is an NPL site an is being conducted as a Major System Acquisition under the Surplus Facilities Management Program (SFMP) of the US Department of Energy. The major goals of the SFMP are to eliminate potential hazards to the public and the environment that are associated with contamination at SFMP sites and to make surplus real property available for other uses to the extent possible. To this end, the DOE WSSRAP is carrying out the environmental compliance and remedial activities necessary to remove, treat, as appropriate, and dispose of contaminated materials in two noncontiguous areas: (1) the raffinate pits and chemical plant and (2) the quarry. The raffinate pits and chemical plant is an area of approximately 220 acres and includes contaminated structures and equipment, soils, sludges, surface and groundwater, and vicinity properties. The quarry site also includes contaminated groundwater and vicinity properties. The WSSRAP environmental compliance strategy has two significant components. First, the bigger decision of chemical plant remediation and waste disposal will follow an integrated approach for compliance with NEPA and CERCLA. Second, during the period that the RI/FS-EIS process is being carried out, a number of expedited response actions will take place.

44794 (CONF-8810239–Absts., pp. 3.139) **Comparison of doses, before and after remedial action.** Wallo, A. III (Dept. of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The Division of Facility and Site Decommissioning Projects at DOE-Headquarters is evaluating potential doses from vicinity properties before and after remedial action at several sites using the RESRAD computer code. A preliminary review was completed for nineteen Colonie vicinity properties. This review indicated potential doses before remedial action at these sites ranged from about 43 to 2 mrem/year and after remediation between 5 and 0 mrem/year. These estimates indicate the conservatism in the DOE-derived soil decontamination remedial action. Following remedial action, the potential doses are on the order of those being considered to be below regulatory concern by EPA and NRC. The estimates made for these sites are still conservative due to the method used to determine the source term. More realistic assessments of source terms are anticipate dot significantly affect the after-remedial-action doses, possibly lowering them all to below 1 mrem/year. This evaluation is being refined with more realistic estimates of the source term, for all of the Colonie vicinity properties. Once the Colonie vicinity properties are completed, at least three other sites will be evaluated. It is hoped that this information will provide added confidence in the remedial action guidelines and more general acceptance of the guidelines by the EPA and others.

44795 (CONF-8810239–Absts., pp. 3.3-3.18) **Effect of freezing and thawing on UMTRA covers.** Rager, R. (Sergent, Hauskins, and Beckwith, Albuquerque, NM (USA)); Smith, G.; Brody, R. USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The proposed US Environmental Protection Agency (EPA) groundwater standards (40 CFR 192) require that Uranium Mill Tailings Remedial Action (UMTRA) Project remedial action designs meet low numerical limits for contaminants contained in water or vapor exiting the embankments. To meet the standards, a cover of compacted fine-grained soil is placed over UMTRA Project embankments. One of the functions of this cover is to limit infiltration. The hydraulic conductivity of this infiltration barrier must be low in order to reduce seepage from the cell to the extent necessary to comply with the proposed EPA groundwater standards. Analyses of infiltration barriers covered with rock erosion protection show that the infiltration barriers may become saturated. Accordingly, it is necessary to assure that freezing and thawing of the infiltration barrier materials do not affect the performance of the embankment. A study has been conducted to determine if the hydraulic conductivity of fine-grained clayey soils used or proposed for use in radon/infiltration barriers is affected by repeated freezing and thawing cycles. In addition, a procedure for determining the depth of frost penetration has been developed. Laboratory freeze-thaw tests were undertaken in order to determine if the saturated hydraulic conductivity of clay soils used in UMTRA Project radon/infiltration barriers was affected. The results indicate that an increase of an order of magnitude or more in saturated hydraulic conductivity may occur during repeated freeze-thaw cycles.

44796 (CONF-8810239–Absts., pp. 3.55-3.70) **UMTRA nonradiological toxins cleanup methodology (DECHEM).** Richey, R. (Dept. of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Remedial investigations at Uranium Mill Tailings sites have indicated that metallic toxicants may be more mobile than the radiological constituents that have generally been emphasized in remedial planning. Regulatory guidelines are presently lacking for the cleanup of metallic toxicants from subpile soils or adjacent areas of windborne or waterborne contamination. A procedure has been developed in support of the Uranium Mill Tailings Remedial Action (UMTRA) Project to guide the characterization and remedial planning for these elements at twenty-four UMTRA Project sites. The procedure generates site-specific cleanup criteria based on acceptable levels of health risk associated with exposure to the most hazardous toxicants. At the heart of the procedure is a pathway analysis approach for determining the acceptable residual levels of metallic toxicants that may remain in the soil after a remedial action has been completed. The analysis utilizes a technique names DECHEM that closely parallels the DECOM method already developed for radionuclides at mixed waste sites. The methodology employs user-friendly microcomputer software that permits the insertion of site-specific parameters to guide the characterization and management of metallic toxicants at a given mill tailings site. DECHEM has been implemented on a trial basis at two UMTRA Project sites: Green River, Utah and Riverton, Wyoming.

44797 (CONF-8810239–Absts., pp. 3.71-3.82) **Status report vicinity property remedial action standards, verification and certification.** Tucker, M.K. (Dept. of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Under the authority of the Atomic Energy Act, the Uranium Mill Tailings Radiation Control Act (UMTRAP), and 40 CFR 192 (EPA Standards for Remedial Action at Inactive Uranium Processing Sites), remedial action standards have been developed for formerly utilized sites under the Remedial Action Program (FUSRAP), facilities involved in the Surplus Facilities Management Program (SFMP), and facilities participating in the Uranium Mill Tailings Action Program (UMTRAP). Remedial action standards for FUSRAP and SFMP specify basic dose limits, guidelines for residual radioactivity, and management practices for the control of radioactive wastes and residues. Remedial action standards for UMTRAP are specific to Radium-226, radon decay product concentration, and gamma radiation. The remedial action standards for FUSRAP/SFMP and UMTRAP are reasonable and appropriate. Differences between the two Remedial Action Programs are due to differences in authorizing legislation and type of contamination. It is recommended, however, that FUSRAP/SFMP sites adopt the UMTRAP standard for Thorium-230 and that UMTRAP sites adopt FUSRAP/SFMP Hot Spot criteria for remediation purposes. The verification procedures for FUSRAP/SFMP and for UMTRAP are very similar, except for the extent of verification. It is recommended that DOE management review the discrepancy between the existing FUSRAP/SFMP requirement of 100% independent verification and the existing UMTRAP requirement of 10% independent verification.

44798 (CONF-8810239–Absts., pp. 4.1-4.18) **Hot cell equipment decontamination, size reduction and disposal at the Pacific Northwest Laboratory.** Holton, L.K. Jr. (Pacific Northwest Lab., Richland, WA (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The Pacific Northwest Laboratory (PNL) is currently engaged in a major program in which six radiochemical hot cells are being remotely cleaned out and decontaminated. Four of these hot cells have been used for the past twenty years for the development and testing of pilot-scale equipment systems for: spent nuclear fuel shearing and dissolution, dissolver solution reprocessing, waste vitrification, liquid waste treatment, process condensate treatment, borosilicate glass canister processing, and off-gas treatment. Two additional hot cells have been used for waste from sample preparation, spent fuel and borosilicate glass leaching studies, small scale west chemistry studies and small scale radioisotope purification processing. The cleanout approach for each of the six hot cells is being tailored to each cell based upon the contamination level and type of contamination found in each cell, and the waste types found in the cell. The waste handling strategy for the Hot Cell Cleanout Program is summarized. The strategy is designed to minimize impact to the Hanford site burial ground, reduce overall program cost and minimize worker radiation exposure. Contamination levels of equipment within the cells vary in terms of exposure rates from 1000 Rad/hr of mixed fission product to greater than 100,000 Rad/hr beta/gamma activity. Waste types to be removed during the cell cleanout effort include Low-Level Waste (LLW), Transuranic Waste (TRU), Potential TRU and Radioactive Mixed Waste (RMW). Waste is characterized and segregated into waste types to minimize overall disposal and reduce staff exposure.

44799 (CONF-8810239–Absts., pp. 5.141-5.143) **EPA's approach to regulation of mixed waste and status of future activities.** Shackleford, B. (Environmental Protection Agency, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Regulation of radioactive mixed waste is a topic that has received much attention in the past several years. Much of the discussion and confusion stemmed from uncertainty about applicable regulatory authorities. On July 3, 1986, EPA clarified its position that the Resource Conservation and Recovery Act (RCRA) applied to the hazardous component of radioactive mixed waste. The Agency announced this clarification in the Federal Register and informed States that they must seek authority to regulate mixed waste in order to obtain or maintain RCRA authorization to administer and enforce a hazardous waste program in lieu of EPA. Since that time, five States have received authorization to regulate mixed waste: Colorado, South Carolina, Tennessee, Washington, and Georgia. Authorized States issue RCRA permits in lieu of EPA. Currently, 44 States have been authorized for the base RCRA program, Conversely, 12 States and Trust Territories have no RCRA authorization. In these States and territories, EPA administers that RCRA hazardous waste program. A more stringent State requirement occurs when a State allows less time for compliance than would be provided under Federal law, for example. There is a third authorization category with respect to mixed waste that I have yet to address. This category is made up of States which have EPA authorization to regulate hazardous waste but have yet to obtain mixed waste authorization. Most States fall into this category. In these States, of which there are 39, mixed wastes are not hazardous wastes and subject to Subtitle C regulations.

44800 (CONF-8810239–Absts., pp. 5.145-5.156) **Conversion of mixed waste to radioactive waste: a case study.** Liedle, S. (Bechtel National, Inc., Oak Ridge, TN (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

As part of the US Department of Energy's (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP), Bechtel National performed remedial actions at the National Guard Armory (NGA) in Chicago, Illinois. The scope of FUSRAP includes sites such as the NGA which were used for uranium storage and processing under the jurisdiction of the Manhattan Engineer District and the Atomic

Energy Commission during the development and the nation's atomic energy program. During remedial actions at the NGA, sixteen 55-gallon (208-liter) drums of sludge were removed from catch basins and drain lines in the garage area of the Armory. This sludge was contaminated with uranium-238 at concentrations up to 14,000 picoCuries per gram as a result of the aforementioned uranium processing. The sludge also contained lead and several volatile organic compounds. Several options for disposing of the sludge were explored; treatment and disposal at existing radioactive waste disposal sites, incineration, supercritical water oxidation, and microwave treatment. Each of these options however was eliminated due to cost, technical feasibility, and/or regulatory restrictions. As a result, bench scale tests were conducted on samples of the sludge to identify techniques for separating the chemical and radiological hazards so the sludge could be disposed. Thermal treatment was selected for field implementation when bench scale thermal tests raised the flash point of a sample of sludge to above 800°F (426.7 C), well above the RCRA criterion.

44801 (CONF-8810239–Absts., pp. 5.43-5.57) **Two new field measurements for D&D: rapid Th-230 determinations and detection of rad waste in and surrounding sewer or process lines.** Duray, J.R. (UNC Geotech, Grand Junction, CO (USA)). US-DOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The Technical Measurements Center has developed a rapid thorium-230 field measurement method. The field method is much faster than the conventional practice of sending soil samples to a laboratory for analysis. Including the time to take a soil sample, the method yields a result in about one hour. Miniature gamma-ray and beta detectors have been coupled to a portable scaler through a long, flexible adaptation of a plumber's snake. Both detector assemblies and, in particular the gamma detector, are state-of-the-art in miniaturization and durability. The detector assemblies are small enough to easily pass through a three-inch sewer trap. Future proposed work will add a surface unit to locate the detector in the buried line. Other applications of the gamma unit are logging shallow boreholes and probing for radiometric contamination under slabs instead of drilling through the slab.

44802 (DOE/ER–0149) **Evaluation of mid-to-long term basic research for environmental restoration: Preliminary analysis to characterize DOE waste problems in a 5- to 20-year timeframe and to identify research needs.** USDOE Office of Energy Research, Washington, DC (USA). Sep 1989. 163p. Sponsored by U.S. DOE Energy Research. Order Number DE89015621/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This document describes a long-term basic research program for the US Department of Energy (DOE) that complements departmental initiatives in waste management and site cleanup. The most important problems faced by DOE are environmental restoration of waste sites and cleanup of inactive facilities. Environmental restoration is defined in this report as characterization, assessment, remediation, and post-closure verification within the waste/environmental system at DOE sites. Remediation of inactive, contaminated waste-disposal sites is the largest and most expensive task facing DOE. Immobilization, isolation, separation, and destruction of waste, either aboveground or in situ, are difficult and costly tasks. Technologies for these tasks are primitive or do not exist. Departmental problems in the long term are being analyzed scientifically and research needs are being identified. When completed, the Office of Energy Research's (OER's) basis research plan will describe potential scientific research needs for universities, national laboratories, and others as a basis for research proposals to DOE. Extensive interaction with the scientific community is planned to further refine and prioritize research needs. Basic research within DOE is directed toward fundamental knowledge leading to the discovery of new scientific or engineering concepts and principles that may or may not have immediate specific technological applications. However, because DOE is a mission-oriented agency, basic research in DOE is strongly influenced by national energy and environmental policy and may be multidisciplinary in nature. Basic research will provide innovative concepts and the fundamental knowledge base that facilitates the development and application of new and emerging technologies. 41 refs., 5 figs., 9 tabs.

44803 (DOE/NE/44139–42) **Vitrification process equipment design for the West Valley Demonstration Project.** Chapman, C.C.; Drosjack, W.P. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Oct 1988. 68p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89009021/JAW. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

The vitrification process and equipment design is nearing completion for the West Valley Project. This report provides the basis and current status for the design of the major vessels and equipment within the West Valley Vitrification Plant. A review of the function and key design features of the equipment is also provided. The major subsystems described include the feed preparation and delivery systems, the melter, the canister handling systems, and the process off-gas system. 11 refs., 33 figs., 4 tabs.

44804 (DOE/NE/44139–51) **Verification of product quality from process control—preliminary results.** Pegg, I.L.; Saad, E.; Freeborn, W.P.; Macedo, P.B. West Valley Nuclear Services Co., Inc., West Valley, NY (USA). Aug 1988. 46p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-81NE44139. Order Number DE89015324/JAW. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

This paper describes how, using reasonable assumptions, a simple model for the West Valley Demonstration Project (WVDP) vitrification process can be constructed. Well-developed statistical ideas are then used to determine the consequences of the expected variations in process control variables, first in terms of glass product composition and then in terms of glass properties. Simple models for melt viscosity and glass chemical durability are presented and show how such models may be combined with the process model to verify product quality. The region most likely encompassing process variations is defined, and by requiring that this lies entirely within the region of acceptable glasses, we arrive at the present WVDP reference composition, WVW-RG4. To the extent that the assumptions described are valid, a point that will be tested at WVDP, it is concluded that the WVDP, as presently characterized, can successfully produce glasses that are both processible and of acceptable durability. Finally, the extensions and refinement of this work in progress are presented. 7 refs., 22 figs., 4 tabs.

44805 (DOE/OR/21548–062) **Waste assessment radiological characterization of the Weldon Spring Site raffinate pits.** MK-Ferguson Co., St. Charles, MO (USA); Jacobs Engineering Group, Inc., St. Charles, MO (USA). Aug 1989. 100p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-86OR21548. Order Number DE89016202/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

As part of the remedial investigation efforts conducted at the Weldon Spring Site Remedial Action Project (WSSRAP), it was recognized that an assessment of the nature and extent of the types of waste in the Weldon Spring Raffinate Pits (WSRP) was necessary to evaluate treatment and disposal alternatives. A sampling plan was developed, therefore, which detailed sample locations, sample parameters, and sampling techniques. The sampling effort consisted of collecting 145 samples from 42 locations. The sampling locations were evenly distributed across each of the four raffinate pits in terms of both area and depth. The samples were analyzed for long-lived radionuclides from the natural uranium and natural thorium transformation series. The average, standard deviation, minimum, and maximum were determined for the selected radionuclides for each pit. The data were then evaluated and interpreted specific to each pit and for each radionuclide. At a later date the surface waters of each pit were sampled and similarly analyzed. 11 refs., 8 figs., 18 tabs.

44806 (DOE/SSDP–0066) **Shippingport station decommissioning project technology transfer program.** McKernan, M.L. USDOE Shippingport Station Decommissioning Project Office, PA (USA). 1988. 19p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930;AC06-84RL10421. (CONF-890604–13: Annual meeting of the American Nuclear Society, 4-8 Jun 1989).

Order Number DE89016831/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

US Department of Energy (DOE) Shippingport Station Decommissioning Project (SSDP) decommissioned, decontaminated, and dismantled the world's first, nuclear fueled, commercial size, electric power plant. SSDP programmatic goal direction for technology transfer is documentation of project management and operations experience. Objective is to provide future nuclear facility decommissioning projects with pertinent SSDP performance data for project assessment, planning, and operational implementation. This paper presents a working definition for technology transfer. Direction is provided for access and availability for SSDP technology acquisition.

44807 (DOE/SSDP–0068) **Shippingport Station Decommissioning Project site release protocol.** Handy, J.W. USDOE Shippingport Station Decommissioning Project Office, PA (USA). 1988. 25p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930;AC06-84RL10421. (CONF-890604–14: Annual meeting of the American Nuclear Society, 4-8 Jun 1989). Order Number DE89016832/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The Richland, Washington field office of the DOE and its Remedial Actions Contractor, GE, took possession of the SSDP site in September 1984. In February of the following year, DOE-HQ issued generic, site independent guidelines taken from existing radiation protection standards. Basic generic dose limits were English equivalents of 1 mSv (100 mrem) per year averaged over the lifetime of any individual member of the general public. Hot spot limits were given. Occupied or habitable structures were limited to 5.2×10^{-9} C/Kg h (20mR/h). Surface contamination was limited to standards plus average and maximum contact dose rates of 2 microGy (0.2 mrad) per hour and 10 microGy (1 mrad) per hour respectively. In addition, "all exposures ... were to be limited to levels that (were) as low as reasonably achievable (ALARA)." Authorized limits higher than these guidelines were allowed under given exceptional circumstances. GE determined the allowable radionuclide concentrations that could remain in soil and included rubble, and not dose the resident farmer to more than 1 mSv (100 mrem) per year. Under more conservative scenarios, however, exposures were controlled for buried, potentially occupationally occupiable, concrete substructures, to souvenir items, or to buried, but potentially exposed, concrete slabs. GE incorporated the scenario's pathways into a document implementing specific site release criteria which cannot be exceeded if the site is to be released unconditionally. 3 refs., 1 fig.

44808 (DOE/SSDP–0069) **Progress in the release of the Shippingport site and materials.** Eger, K.J.; Galgoul, M.J.; Gardner, D.L. Westinghouse Hanford Co., Richland, WA (USA); General Electric Co., Shippingport, PA (USA). 30 Jan 1989. 18p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930;AC06-84RL10421. (CONF-890604–15: Annual meeting of the American Nuclear Society, 4-8 Jun 1989). Order Number DE89016833/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The decommissioning of the Shippingport Atomic Power Station involved not only the disassembly of the nuclear side of the plant, but also the disposition of the site structures and equipment by release or by disposal as radwaste. The simple burial of all of this material would have been prohibitively expensive. Furthermore, it would have been unnecessary since the vast majority of the material had little (if any) contact with radioactivity. To save these costs, as well as to protect the public, the materials had to be classified so that the clean materials could be released from the site (or with the site) for unrestricted use. Two separate programs were developed and implemented during the Shippingport Station Decommissioning Project (SSDP) to do just this. One was for the release of material (most notably steel) from the site. The second program was for the disposition of the soil and concrete which would remain and be released with the site. 2 refs.

44809 (HW–39974) **Radiological Sciences Department investigation: Radiation Incident Class 1, No. 536-C.** Wilson, R.H. Hanford Works, Richland, WA (USA). 12 Dec 1955. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89016477/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

An uncontrolled emission of ruptured material from an irradiated uranium charge at the 105-H Reactor Building contaminated a portion of the 100-H Area and environs on November 1, 1955. At approximately 2:05 p.m. on October 31, 1955 instruments for the H-loop facility indicated the possibility of a rupture in tube No. 0961-H. Radiation Monitoring was immediately notified and surveys made a few minutes later on the effluent lines serving this particular loop facility indicated the activity had increased from 100–200 mrads/hr to 2–4 rads/hr.

44810 (HW–81300) **Radionuclides in an abandoned reactor facility.** Koop, W.N. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 11 Mar 1964. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89016480/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Declassified 17 Aug 1989.

The prospect of abandoning one or more of the older Hanford reactors has led to questions regarding the amount of radioactive material that will remain at such an abandoned facility. Specific requests were made for estimates on the curies remaining in a retention basin, in a storage basin, and in a reactor core. The purpose of this report is to provide these estimates and show how they were computed. Radioanalyses of retention basin sludge samples previously indicated the principal radionuclide was zinc-65, with some relatively minor quantities of fission products. Settled radioactive debris in the storage basins are fission products. Less is known about the kind of radioactive materials in a reactor core.

44811 (NUREG/CP–0098-Vol.1, pp. 14-19) **Blueprint for nuclear safety - a nonregulatory strategy.** Knight, J.P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

The Department of Energy operates a nuclear complex that now numbers over 250 facilities nationwide, many of which date back to the 1940s and 1950s. In 1985, Secretary Herrington moved to establish the Office of Environment, Safety and Health, give it needed resources and authorities, and begin extensive environmental protection and safety evaluations of all major DOE sites and facilities. On the nuclear safety side this necessitates an integrated program that not only strengthens oversight but also builds DOE-wide technical capabilities and promotes safety performance. This has led up to focus our attention on three areas: (1) the DOE safety oversight system – its resources, technical capabilities, and effectiveness; (2) the safety policy development and review; and (3) the Department's capabilities to foster technical inquisitiveness and overall excellence in safety performance. The essence of this approach is found in this last term – performance. Performance that is results-oriented; founded on realized safety enhancements and risk reduction, not merely regulation for its own sake. Performance not merely in terms of hardware fixes, but also focusing on the human part of the safety equation.

44812 (Y/MA–6817) **Contamination control projects in 9206 Facility.** Sliski, C.E. Oak Ridge Y-12 Plant, TN (USA). 18 Aug 1989. 24p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OS21400. (CONF-890864–1-Vugraphs: 3. American Glovebox Society annual conference and equipment display, 21-24 Aug 1989). Order Number DE89015989/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

New radiation protection guidelines, outlined by Department of Energy, Oak Ridge Operations in 1986 (DOE Order 5480.11), will lower the respirator level to 11 d/min/m^3 which is a fourth of what it had been. Compliance with the new Order is to be achieved by January, 1991. The Y-12 Enriched Uranium Operations Department evaluated the air count data collected during a 6-month period to identify those areas or processes that were not currently respirator areas, but where the samples were greater than the proposed 11 d/min/m^3 limit. Secondary containment projects were then formulated to reduce the potential for airborne contamination. This contamination control endeavor has been funded with approximately $7 M to

date to begin some of the projects. This presentation will outline the contamination control objectives and projects that use gloveboxes as containment for various equipment, processes, and facilities.

44813 Two-arm master/slave manipulator for nuclear facilities. Tomizawa, F.; Iwatsuka, N.; Suzuki, M.; Senoh, M.; Sugiyama, S. *Transactions of the American Nuclear Society (USA)*, 57: 334-335 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Several kinds of one-arm manipulators have been developed for remote maintenance in nuclear facilities to reduce personnel radiation exposure and to keep plant availability as high as possible. In those maintenance tasks, however, there are many that need two arms, e.g., one arm holds the work object and the other arm cuts it with a plasma torch. To answer this need, a dexterous two-arm master/slave manipulator has been developed based on the technology for one-arm manipulators. A prototype two-arm/slave manipulator is shown. The specifications for master and slave manipulators are listed. The prototype two-arm manipulator is undergoing laboratory performance tests. Preliminary results showed the maximum static operating forces were 0.4 N for the all-direct drive (DD)-type arm and 1.1 N for the semi-DD type. The payload for each arm of the slave manipulator was confirmed as 10 kg_f, using mock pieces. The decommissioning tasks of cutting pipes and steel plates were successfully carried out.

0550 Safeguards, Inspection, and Accountability

Refer also to citation(s) 45086, 46776

44814 (CONF-8810239–Absts., pp. 4.113) **Tools and techniques used in US Department of Energy decommissioning programs.** Miller, R. L. (Westinghouse Hanford Company, Richland, WA (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Since the decommissioning projects are located at various sites across the United States, a centralized technology transfer program was established to ensure that information on new technologies and techniques developed to support specific tasks is available to all contractors performing similar decommissioning work. This sharing of information avoids duplication of effort and helps to avoid the expenditure of resources on tools or techniques that are not cost effective. This article discusses several of the tools and techniques that have been successfully used for various tasks during the course of decommissioning nuclear facilities. Since decommissioning is labor-intensive work, tools and techniques that reduce either personnel radiation exposure or time required to perform a task are desirable. Other factors that are considered when selecting particular tools or techniques are waste volume reduction, recontamination avoidance, simplicity or operation, and avoiding introduction of large quantities of hazardous/toxic materials that may require special handling and disposal. Finally, the tool, depending on the intended work environment, must be cost effective, easily disposable or easily decontaminated for reuse.

44815 (CONF-8810239–Absts., pp. 4.53-4.71) **Dismantling of JPDR reactor internals by underwater plasma arc cutting technique using robotic manipulator.** Yokota, M. (Japan Atomic Energy Research Institute, Naka-Gun, Ibaraki-Ken). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The actual dismantling of JPDR started on December 4, 1986. As of now, equipment that surrounds the reactor has mostly been removed to provide working space in reactor containment prior to the dismantling of reactor internals. Some reactor internals have been successfully dismantled using the underwater arc cutting system with a robotic manipulator during the period of January to March 1988. The cutting system is composed of an underwater plasma arc cutting device and a robotic manipulator. The cut off reactor internals were core spray block, feedwater sparger and stabilizers for fuel upper grid tube. The plasma arc cutting device was developed to dismantle the reactor internals underwater. It mainly consists of a plasma torch, power and gas supply systems for the torch, and by-product treatment systems. It has the cutting ability of 130 mm thickness stainless steel underwater. The robotic manipulator has seven degrees of freedom of movement, enabling it to move in almost the same way as the arm of a human being. The arm of the robot is mounted on a supporting device which is suspended by three chains from the support structure set on a service floor. A plasma torch is griped by the robotic hand; its position to the structure to be cut is controlled from a remote control room, about 100 meters outside the reactor containment.

44816 (CONF-8810239–Absts., pp. 4.73-4.96) **Removal of JRR-3 biological shield concrete and mock-up tests of diamond sawing and coring technique of JPDR biological shield concrete.** Suzuki, S. (Shimizu Corporation, Tokyo (Japan)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Japan Research Reactor No. 3 (JRR-3) of the Japan Atomic Energy Research Institute (JAERI), was removed to a storage facility between October 14th and November 7th, 1986. This removal of the 2250 ton reactor block (10x10x10m) was performed as a part of the program to replace the JRR-3's core (10-MW thermal) with an upgraded research reactor core. After the removal of the reactor, a new 20 MW thermal, light water moderated and cooled JRR-3 core will be built. Criticality is scheduled for 1989. The Japan Power Demonstration Reactor (JPDR) was the first power plant in Japan and was shut down in 1976 after 13 years of operation. The JPDR decommissioning program began in 1981 in order to develop future commercial power plant decommissioning techniques and demonstrate reactor decommissioning techniques under the sponsorship of the Science and Technology Agency in Japan. The biological shield surrounding the pressure vessel is massive, is made up of heavily reinforced concrete and is partially activated. A diamond sawing and coring technique has been developed for the highly activated concrete dismantlement along with an abrasive water jet cutting technique.

44817 (IAEA-INFCIRC–361) **Agreement of 23 February 1989 between the Government of the Democratic People's Republic of Algeria and the International Atomic Energy Agency for the application of safeguards in connection with the supply of a research reactor from the Republic of Argentina.** International Atomic Energy Agency, Vienna (Austria). May 1989. 11p. Order Number DE89636506/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Hard copies are available in English, Arabic and French from IAEA Division of Publications, Distribution Unit.

The document reproduces the text of the Agreement of 23 February 1989 between the Government of the Democratic People's Republic of Algeria and the IAEA for the application of safeguards in connection with the supply of a 1 MW thermal training and research reactor from the Republic of Argentina.

44818 (IAEA-INFCIRC–364) **Inspection of Iraq's nuclear facilities.** International Atomic Energy Agency, Vienna (Austria). May 1989. 2p. Order Number DE89636512/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The document reproduces the letter dated 14 April 1989 from the Resident Representative of Iraq to the Deputy Director General for Administration and the letter from the Deputy Director General for Administration to the Resident Representative of Iraq dated 28 April 1989 concerning the statement of the conclusions of the Agency's inspection of Iraq's nuclear facilities.

44819 (IAEA-INFCIRC–366) **Agreement of 17 February 1989 between the United States of America and the International Atomic Energy Agency for the application of safeguards in connection with the treaty for the prohibition of nuclear weapons**

in Latin America. International Atomic Energy Agency, Vienna (Austria). May 1989. 34p. Order Number DE89636507/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The document reproduces the full text of the Agreement of 17 February 1989 between the United States of America and the Agency for the application of safeguards in connection with the Treaty for the Prohibition of Nuclear Weapons in Latin America (Tlatelolco Treaty) on all source or special fissionable material in all peaceful nuclear activities within United States Protocol I Territories for the exclusive purpose of verifying that such material is not diverted to nuclear weapons or other nuclear explosive devices.

44820 (NBL–321) **General analytical evaluation program (GAE): Final report, 1979–1984.** USDOE New Brunswick Lab., Argonne, IL (USA). May 1989. 308p. Sponsored by U.S. DOE Nuclear Energy. Order Number DE89016064/JAW. Available from NTIS, PC A14/MF A01 - OSTI; GPO Dep.

The General Analytical Evaluation Program monitored measurement capabilities of nine participating laboratories on uranium materials representative of those commonly encountered in scrap recovery and fuel production operations. This report presents and evaluates measurement data produced by the participants from October 1979 through June 1984. Two types of measurements are presented: measurements of the uranium in the sample (both uranium concentration and U-235 isotopic abundance) and measurements of twelve nonvolatile impurities contained in the sample. 237 figs., 8 tabs.

44821 (UCRL–101252) **Structured approach to SNM [special nuclear material] anomalies resolution.** Lamont, A.; Strait, R.S. Lawrence Livermore National Lab., CA (USA). 6 Jul 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890736–59: 30. annual meeting of the Institute of Nuclear Materials Management, 9-12 Jul 1989). Order Number DE89016516/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Nuclear facilities are responsible for resolving nuclear materials safeguards anomalies indicating that special nuclear material (SNM) may be missing. These anomalies can have many causes, including simple bookkeeping or measurement errors or malevolent acts by insiders. Determining the likely cause of an anomaly is often complex, time consuming, and costly. In most cases no specific cause can be conclusively proven. Therefore, it is particularly important that investigations of SNM safeguards anomalies be carried out systematically and that all conclusions from the investigation be thoroughly documented and logically justified. Currently there are no standardized methods available for guiding an investigation and drawing conclusions from it. This paper presents a method we are developing which is based on decision analysis techniques and Bayesian probability analysis. The method helps in developing a set of hypotheses about the possible causes of an anomaly and uses the evidence gathered during an investigation to evaluate the likelihood of each hypothesis. The uncertainty in measurements and evidence collection are accounted for in an explicit and quantitative manner. The method suggests the most effective sequence of steps for the investigation and provides guidance on when to terminate the investigation. The method applies to both item and bulk inventory differences, but the evaluation of bulk differences requires a more complex set of procedures than those presented in this report. A simple computer program and training materials are also being developed. The software is being designed to facilitate quick resolution of an anomaly, help guide an investigation team, and document the team's conclusions. 2 figs.

44822 (UCRL–101425) **Hand-off Collusion Module of the ASSESS [Analytic System and Software for Evaluating Safeguards and Security] program.** Fortney, D.S.; Romine, W.A.; Snell, M.K. Lawrence Livermore National Lab., CA (USA). 6 Jul 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890736–60: 30. annual meeting of the Institute of Nuclear Materials Management, 9-12 Jul 1989). Order Number DE89016517/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Many analytic tools have been developed for evaluating the effectiveness of a facility's safeguards and security system against theft of special nuclear material by either insider or outsider adversaries acting alone. However, to date, no tools are available to help evaluate the effectiveness against collusion among insider and outsider adversaries. This paper describes the new Hand-off Collusion Module, a tool for addressing collusion between a single nonviolent insider and outsiders. Developed jointly by Lawrence Livermore National Laboratory and Sandia National Laboratories, the Hand-off Collusion Module is part of the ASSESS program. The module considers the simplest form of collusion, that of a time-independent hand-off in which the insider enters the target area, acquires the target material, and removes it to a hand-off area within the facility. The outsider penetrates the facility to this hand-off area, retrieves the target material, and moves it offsite. The module assumes that each insider/outsider pair will hand off the target material in the area where the combined "probability of system win" is the lowest. Preliminary calculations are made in the Insider and Outsider Modules and passed to the Collusion Module in files. The Collusion Module performs the calculations for each insider/outsider pair in consideration, and presents the results in a variety of tables, graphs, and printed reports. This paper discusses the scope of the module, describes the types of input required and outputs available, and demonstrates the computer code we have developed. 5 refs., 6 figs.

44823 (UCRL–101426) **A comprehensive method for evaluating safeguards against the insider threat: The Insider Evaluation module of ASSESS [Analytic System and Software for Evaluating Safeguards and Security].** Al-Ayat, R.A.; Renis, T.A.; Patenaude, C.J.; Saleh, R. Lawrence Livermore National Lab., CA (USA). 6 Jul 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890736–61: 30. annual meeting of the Institute of Nuclear Materials Management, 9-12 Jul 1989). Order Number DE89016519/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are developing a comprehensive tool for evaluating the effectiveness of safeguards and security systems against theft of special nuclear material by insiders. This tool, the Insider Evaluation module, is an integral part of ASSESS (Analytic System and Software for Evaluating Safeguards and Security) which is being developed jointly by Lawrence Livermore and Sandia National Laboratories. The Insider Evaluation module provides the user with a systematic, easy to use tool and an extensive database for analyzing the insider threat. This paper focuses on demonstrating the software, describing its input requirements and the various output options available to the user. An evaluation using this tool begins by defining the types of potential insider adversaries and specifying their levels of access and types of authority at the facility, as well as any procedures that may affect those theft strategies that take place across multiple facility layers. Users input to the module is facilitated by predefined databases of options from which the user can select those appropriate to their facility. The module identifies the optimal theft scenario and computes the corresponding probability of detection for each potential adversary type. Results are displayed in tables or graphs at varying levels of detail. For example, summary results present the overall probability of detection for each adversary. However, the user can focus, or "zoom," on a particular result to gain further insights about the particular strategies or methods used by the adversaries. The most detailed results specify the best method an adversary could use to defeat each safeguards component at a path element to accomplish a particular strategy. Use of the predefined database of strategies and probabilities helps create consistent results and helps document the modeling assumptions used. 6 refs., 9 figs.

44824 (UCRL–101570) **Developing a database for helping evaluate safeguards effectiveness against insider adversaries.** Saleh, R.; Sicherman, A. Lawrence Livermore National Lab., CA (USA). 6 Jul 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890736–62: 30. annual meeting of the Institute of Nuclear Materials Management, 9-12 Jul 1989). Order Number DE89016521/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Lawrence Livermore National Laboratory (LLNL) has been developing assessment models to systematically evaluate the performance of safeguards and security systems against a potential theft attempt of nuclear material by a nonviolent insider adversary. These models are part of a comprehensive safeguards evaluation

package called ASSESS which is being developed jointly by LLNL and Sandia National Laboratories. To help "standardize" and provide comparable and consistent model results when used by different analysts at different facilities, a predefined database was needed. The insider database we are developing provides a comprehensive list of strategies and specifies probabilities of detection that depend on various target material and safeguards characteristics, adversary attributes, and the particular methods employed to defeat individual safeguards components. The model and database structure attempt to adequately address all important considerations while simplifying user input and running within a reasonable amount of time on a microcomputer. In this paper, we describe the organizational structure underlying the ASSESS insider database. We focus on how the database allows most situations of interest to be tractably yet reasonably modeled and provides the users with a well-defined and consistent assignment of probabilities of detection for a core set of events from which overall theft scenarios may be comprised and then evaluated. 4 refs., 1 fig., 3 tabs.

44825 (WHC-SA–0337) **Application of quality assurance to scientific activities at Westinghouse Hanford Company.** Delvin, W.L.; Farwick, D.G. Westinghouse Hanford Co., Richland, WA (USA). Jun 1988. 11p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-87RL10930. (CONF-880631–61: 29. annual meeting of the Institute of Nuclear Materials Management, 26-29 Jun 1988). Order Number DE89016056/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The application of quality assurance to scientific activities has been an ongoing subject of review, discussion, interpretation, and evaluation within the nuclear community for the past several years. Much of the focus on this subject has dealt with the difficulties encountered in relating the concepts of quality assurance to scientific activities, particularly when those concepts are presented in traditional quality assurance formats and terminology. This paper provides a discussion on the natures of science and quality assurance and presents suggestions for integrating the two successfully. The paper shows how those actions were used at the Westinghouse Hanford Company to successfully apply quality assurance to experimental studies and materials testing and evaluation activities that supported a major project. An important factor in developing and implementing the quality assurance program was the close working relationship that existed between the assigned quality engineers and the scientists. The quality engineers, who had working experience in the scientific disciplines involved, were able to bridge across from the scientists to the more traditional quality assurance personnel who had overall responsibility for the project's quality assurance program. 8 refs.

0560 Legislation and Regulations

Refer also to citation(s) 44701, 44720, 44795, 44797

44826 (CONF-8810239–Absts., pp. 2.63-2.80) **Overview of the Department of Energy defense programs environmental restoration programs.** Lehr, J.C. (Dept. of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

The Department of Energy (DOE) established the Environmental Restoration (ER) Program in 1987 to coordinate the remediation of Defense Programs (DP) inactive hazardous waste sites and to take corrective actions for any releases of hazardous wastes from any waste management unit meeting the definition of a past disposal site. While DOE has supported environmental restoration activities, the management and coordination have not always been focused and the funds spent on those activities have not always been visible. To optimize the use of the funds, a separate budget category was identified to meet the corrective action requirements for inactive sites under the Resource Conservation and Recovery Act (RCRA) 3004(u) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)/Superfund Amendments and Reauthorization Act (SARA). Management responsibility for the ER Program was assigned to the Office of Defense Waste and Transportation Management (DWTM).

44827 (IAEA-INFCIRC–193(Add.4)) **Text of the Agreement between Belgium, Denmark, the Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, Spain, the European Atomic Energy Community and the Agency in connection with the Treaty on the Non-Proliferation of Nuclear Weapons.** International Atomic Energy Agency, Vienna (Austria). May 1989. 1p. Order Number DE89636505/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

On 5 April 1989 the Agency received in respect of the European Atomic Energy Community and Spain the notification required by Article 23(a) of the Agreement of 5 April 1973 between Belgium, Denmark, the Federal Republic of Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, the European Atomic Energy Community and the Agency, which therefore came into force for Spain on that date.

44828 (IAEA-INFCIRC–367) **Letter to the Director General from the Resident Representative of Israel.** International Atomic Energy Agency, Vienna (Austria). Jun 1989. 2p. Order Number DE89636508/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The document reproduces the letter dated 30 May 1989 to the Director General from the Resident Representative of Israel in response to the statement from 5 April 1989 of the Official Spokesman of the Iraqi Ministry of Foreign Affairs (circulated in document IAEA-INFCIRC-362).

07 ISOTOPE AND RADIATION SOURCE TECHNOLOGY

0701 Physical Isotope Separation

Refer also to citation(s) 45718

0702 Radiation Sources

44829 (AECL–9084) **Gamma and electron beam curing of polymers and composites.** Saunders, C.B.; Dickson, L.W.; Singh, A. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 14p. (CONF-8705187–: 37. Canadian chemical engineering conference (Canadian engineering centennial convention), 18-22 May 1987). Order Number DE89635410/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Radiation polymerization has helped us understand polymer chemistry, and is also playing an increasing role in the field of practical applications. Radiation curing has a present market share of about 5% of the total market for curing of polymers and composites and the annual growth rate of the radiation curing market is $\geq$20% per year. Advantages of radiation curing over thermal or chemical curing methods include: improved control of the curing rate, reduced curing times, curing at ambient temperatures, curing without the need for chemical initiators, and complete (100%) curing with minimal toxic chemical emissions. Radiation treatment may also be used to effect crosslinking and grafting of polymer and composite materials. The major advantage in these cases is the ability to process products in their final shape. Cable insulation, automotive and aircraft components, and improved construction materials are some of the current and near-future industrial applications of radiation curing and crosslinking. 19 refs.

44830 (LA-UR–89-2920) **Proceedings of the 10th meeting of the International collaboration on advanced neutron sources.** Hyer, D.K. (comp. and ed.). Los Alamos National Lab., NM (USA). Mar 1989. 847p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8810182–32: International collaboration on advanced neutron sources (ICANS), 3-7 Oct 1988). Order Number DE89016602/JAW. Available from NTIS, PC A99/MF A01; OSTI; INIS; GPO Dep.

This report contains papers from the 10th meeting of the International Collaboration on Advanced Neutron Sources. Two general types of workshops are discussed, instrument and target-station. Individual papers are indexed separately elsewhere. (LSP)

44831 (ORNL/TM–11234) **Advanced neutron source final preconceptual reference core design.** Copeland, G.L.; Gambill, W.R.; Harrington, R.M.; Johnson, J.A.; Peretz, F.J.; Reutler, H.; Ryskamp, J.M.; Selby, D.L.; West, C.D.; Yoder, G.L. Oak Ridge National Lab., TN (USA). Aug 1989. 112p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016936/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The preconceptual design phase of the Advanced Neutron Source (ANS) Project ended with the selection of a reference reactor core that will be used to begin conceptual design work. The new reference core consists of two involute fuel elements, of different diameters, aligned axially with a small axial gap between them. The use of different element diameters permits a separate flow of coolant to be provided for each one, thus enhancing the heat removal capability and increasing the thermal-hydraulic margins. The improved cooling allows the elements to be relatively long and thin, so self-shielding is reduced and an acceptable core life can be achieved with a relatively small loading of highly enriched uranium silicide fuel clad in aluminium. The new reference design has a fueled volume 67.4 L, each element having a heated length of 474 mm and a radial fuel thickness of 66 mm. The end-of-cycle peak thermal flux in the large heavy-water reflector tank around the core is estimated to be in the range of 0.8 to 1.0 $\times$ 10^{20} $m^{-2} \cdot s^{-1}$. 7 refs., 23 figs., 15 tabs.

44832 **Switchable radioactive neutron source device.** To Dept. of Energy, Washington, DC. USA Patent 4,829,191. 9 May 1989. Filed date 6 Nov 1987. V Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

This invention is a switchable neutron generating apparatus comprised of a pair of plates, the first plate having an alpha emitter section on it and the second plate having a target material portion on it which generates neutrons when its nuclei absorb an alpha particle. In operation, the alpha portion of the first plate is aligned with the neutron portion of the second plate to produce neutrons and brought out of alignment to cease production of neutrons.

0703 Isotopic Power Supplies

Refer also to citation(s) 45397

44833 (WHC-SA–0385) **Radioisotope Power System Facility shielding analysis.** Lu, A.H.; Morford, R.J. Westinghouse Hanford Co., Richland, WA (USA). Jan 1989. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-890408–16: Advances in nuclear engineering computation and radiation shielding, 9-13 Apr 1989). Order Number DE89015578/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A series of calculations for the Radioisotope Power System Facility have been performed. These analyses have determined the shielding required for storage, testing, and transport of ^{238}Pu heat source modules using the Monte Carlo code MCNP3B. The source terms and the assumptions used have been verified by comparison of calculated dose rates with measured ones. This paper describes the methodology used for shielding designs and the utilization of available variance reduction techniques to improve the computational efficiency. The new version of MCNP (MCNP3B) with a repeated structure capability was used. It decreased the chance for computer model errors and greatly decreased the model setup time. 2 refs., 3 figs., 2 tabs.

09 OTHER SYNTHETIC AND NATURAL FUELS

0901 Hydrocarbon Fuels

Refer also to citation(s) 44563, 44564, 44565, 44566, 44567, 44568, 44569, 44570, 44571, 44572, 44573, 44894, 44905, 45703, 45717

44834 (DOE/ER/13719–3) **[One carbon metabolism in anaerobic bacteria: Regulation of carbon and electron flow during organic acid production]: Progress report.** Michigan Biotechnology Inst., Lansing, MI (USA). [1989]. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13719. Order Number DE89016450/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our main emphasis was on the characterization of the enzymes involved in the regulation of single carbon metabolism; characterization of the enzyme activities and pathways responsible for conversion of multi-carbon components to acetate and propionate or butyrate in the above microbial species; purification and characterization of electron carriers; characterization of electron flow pathways and key regulating enzymes; documentation of the physiological function of hydrogen metabolism; and, identifying the influence of pH extremes on the growth of physiology of the acidogenic anaerobes. The results will be summarized below according to the specific organisms studied and covers published or completed research papers in review. At the end of the report reprints and preprints of these manuscripts are attached.

44835 (DOE/METC–89/4089) **Literature review on catalytic conversion of methane to C_2-hydrocarbons: Technical note.** Siriwardane, R.V. USDOE Morgantown Energy Technology Center, WV (USA). May 1989. 30p. Sponsored by U.S. DOE Fossil Energy. Order Number DE89000938/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Various catalysts have been used in the past for the oxidative coupling reaction of methane. This report is a literature review and chronological summary of work from 1978 to 1988 on the catalytic partial oxidation of methane to higher hydrocarbons (mainly ethane and ethylene). Catalysts used and their important properties; the effects of significant parameters on catalyst activity; maximum C_2 yields on these catalysts; and proposed reactions, mechanisms, and catalytic stabilities are discussed. In addition, the results of different research groups who worked on similar catalysts are compared. Based on the literature review, basicity, surface area, and specific active centers produced in the presence of alkali material on the surface are found to be the important factors that affect the C_2 yields on the catalysts. The proposed reaction mechanisms are still controversial, and both free radicals of CH_3 and carbenes have been identified as intermediates. A stable, selective catalyst that produces high C_2 yield is yet to be found. 56 refs., 3 tabs.

44836 (DOE/PC/70028–T11) **Improved catalysts for liquid hydrocarbon fuels from syngas: Technical progress report, April–June 1988.** Union Carbide Corp., Tarrytown, NY (USA). Tarrytown Technical Center. 1988. 211p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-84PC70028. Order Number DE89015524/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The objective of the contract is to consolidate the advances made during the previous contract in the conversion of syngas to motor fuels using Molecular Sieve containing catalysts and to demonstrate the practical utility and economic value of the new catalyst/process systems with appropriate laboratory studies. This report contains results on the following: (A) catalyst characterization studies: detailed listing of the XPS/microreactor data, (B) catalyst testing: details of runs initially reported during last quarter, and (C) techno-economic evaluation of the Co/X11/X9/TC-123 catalyst. 54 figs., 72 tabs.

44837 (SAND–89-1398C) **Use of molecular modeling to design alkane activation catalysts.** Shelnutt, J.A. Sandia National Labs., Albuquerque, NM (USA). 28 Jul 1989. 32p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890814–2: American Institute of Chemical Engineer's summer national meeting, 20-23 Aug 1989). Order Number

DE89016185/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Efficient alkane-activation catalysts are needed for a number of applications including methane conversion to liquid fuels, clean-up of dilute waste streams, and for oxidation of higher molecular weight alkanes, olefins, and aromatics. For some of these applications, high selectivity and regioselectively of the catalyst is desired. Our work takes a biomimetic approach to the development of shape and size selective catalysts using computer-aided molecular design (CAMD) techniques. The biomimetic CAMD methodology consists of several elements, including: (1) investigation of biological catalysts, especially those like methane monooxygenase and cytochrome P_{450} that activate C-H bonds, to determine the structural features to be designed into a synthetic catalyst, (2) molecular mechanics calculations to evaluate potential catalysts, (3) synthesis of the designed catalyst, (4) spectroscopic characterization of the synthetic catalysts, and (5) catalyst testing for activity and selectivity. The activity tests and structural information provide a basis for making further improvements in the catalyst design. This biomimetic CAMD methodology is being used to design shape and size selective catalysts based on the metalloporphyrins. Designed metalloporphyrins with bulky substituents attached so as to give a small methane-binding cavity at the active metal center have been synthesized and tested. The photochemical production of the co-reductant required in the reaction that mimics cytochrome P_{450} and the synthesis of bis-deep-pocket porphyrins are also described. 51 refs., 8 figs.

0902 Alcohol Fuels

Refer also to citation(s) 44905

44838 (CERI–29) **Towards a commercial future. Ethanol and methanol as alternative transportation fuels.** Heath, M. Canadian Energy Research Inst., Calgary, AB (Canada). 1989. 360p. (MICROLOG–89-02719). Available from Canadian Energy Research Institute, 3512-33rd St. NW, Calgary, AB, CAN T2L 2A6; $45.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objective of this study is to review, on the basis of available information, recent developments in the Canadian gasoline markets and to examine the likely developments in sourcing, pricing, and competition for alcohol fuels, in relation to each other and to gasoline in the regional markets. The advantages, disadvantages and current use of six oxygenates that have been considered as fuel additives for octane enhancement in Canada are discussed. Following this is a discussion regarding the oxygenates of choice for this study and the standards they may have to meet by in order to be competitive alternative fuels for Canada. The advangages of ethanol to the Canadian transportation system as an octane enhancer is described. Suggestions are made as to how the long-run prospects for ethanol use in Canada may ultimately be determined. Problems facing this country's methanol producers are discussed as well as the benefits of substituting methanol for diesel fuels with the aim of providing both an alternative fuel source as well as a cleaner environment. Also described are the implications of using ethanol and methanol as alternative fuel sources for the stakeholders involved. Necessary pre-steps that will be required in order to maintain harmony between all the players affected by this industry are suggested. A glossary, and a list of selected recent publications of the CERI are included.

44839 (MWL–8703) **Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 1.** Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. 43p. (MICROLOG–89-00772). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A research project was initiated to define conditions for carrying out a cost-effective process for the SO_2-catalyzed conversion of biomass to butanol and ethanol. The feedstocks studied were aspen chips, sawmill residues, wood chips, and corn stover. An anoxic chamber was used for butanol fermentation, and a bench-scale direct steam reactor for prehydrolysis and hydrolysis of the biomass. A number of significant findings from this research are summarized. Prehydrolysis of biomass employing a small amount of SO_2 as catalyst is highly effective as pretreatment ahead of either acid or enzymatic hydrolysis. It gives rise to fewer problems in fermentation then other acids, or in using pretreated stock for enzyme production. Simultaneous fermentation of pentose and hexose sugars such as are formed on hydrolysis of biomass can be carried out rapidly and efficiently. The technology for enzyme hydrolysis of SO_2-pretreated biomass has been worked out on the small scale, with ethanol yields in the range of 360 to 390 liters per dry tonne of biomass. When enzyme hydrolysis is carried out simultaneously with fermentation by a mixed culture of cellobiose- and pentose-fermenting yeasts, no cellobiase enzyme is required, the process is rapid and efficient, and ethanol yields of about 85% are reached. Extractive butanol fermentation overcomes product inhibition and produces butanol in higher concentrations and in higher yields than nonextractive fermentation. A new continuous dynamic immobilized cell bioreactor is good for very rapid and efficient fermentation, and can be used with ordinary yeast for hexose sugar solutions and with R yeast for pentose-containing solutions such as biomass hydrolysates. 21 refs., 2 tabs.

44840 (MWL–8703) **Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.** Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. 237p. (MICROLOG–89-00772). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Research papers pertaining to a project involving laboratory and pilot studies on a cost-effective process for converting biomass to alcohols are presented. The feedstocks used were various kinds of wood wastes and agricultural waste, and the processes involved pretreatment with sulfur dioxide, hydrolysis, and fermentation using improved strains of yeasts and new bioreactor designs. Individual papers cover such subjects as xylose and cellobiose fermentation, sulfur dioxide pretreatment, immobilized cell bioreactors, extractive fermentation for butanol production, fermentation of spent sulfite liquors, ethanol production, and the characteristics of pentose-fermenting yeasts. Separate abstracts have been prepared for 18 papers from this collection.

44841 (MWL–8703, pp. 7) **Recent advances in xylose and cellobiose fermentation.** Sarad, R.P. (Univ. of Toronto, ON (Canada)); Rannade, P.P.; Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Experimental investigations have shown that successful simultaneous saccharification and fermentation of lignocellulosics with high pentosans can be achieved without beta-glucosidase supplementation when pentose-fermenting yeast is coupled with a cellobiase fermenter. Pichia stipitis R has proven itself an excellent pentose fermenter in whole wood and whole grain hydrolysates. Bretanomyces clausenii is an excellent cellobiose fermenter. P. stipitis CBS5776 ferments both pentoses and cellobiose, but not very rapidly. Mixed cultures produce ethanol from partially hydrolysed wood or other lignocellulosics rapidly, efficiently, with high yields of ethanol. The yield of ethanol from SO_2 prehydrolysed aspen in simultaneous saccharification and fermentation mode with this mixed culture was 384 l/tonne dry wood. No cellobiase was needed in saccharification. 15 refs., 2 figs., 4 tabs.

44842 (MWL–8703, pp. 23) **Ethanol fermentation by pichia stipitis of combined pentose and hexose sugars from lignocellulosics prehydrolysed by SO_2 and enzymatically saccharified.** Wayman, M. (Univ. of Toronto, ON, Canada); Seagrave, C.; Parekh,

S. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Lignocellulosic biomass, namely pine, aspen and corn stover, were prehydrolysed using SO_2 as the hydrolysing catalyst. The prehydrolysis residues were directly saccharified, without washing, by cellulolytic enzymes, whereby about 90% of theoretical yields of sugars were obtained. Fermentation of the hydrolysates containing both the hemicellulose and cellulose sugars by a pentose fermenting yeast, Pichia stipitis R, gave yields of 372, 346 and 388 l ethanol/tonne (dry weight) from pine, aspen and corn stover respectively. The technical aspects of the SO_2 catalysed prehydrolysis and enzymatic saccharification stages and the advantages of fermentation by pentose fermenting yeasts are discussed. 22 refs., 2 figs., 6 tabs.

44843 (MWL–8703, pp. 25) **Performance of a novel continuous dynamic immobilized cell bioreactor in ethanolic fermentation.** Parekh, S.R. (Univ. of Toronto, ON, Canada); Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Continuous ethanol production from glucose, sucrose, cane molasses and corn wet milling waste by cells of Saccharomyces cerevisiae and on first three substrates by cells of Pichia stipitis (R) was investigated. The cells were immobilized on rotating fiber discs by calcium alginate gel in a 2-l novel continuous dynamic immobilized cell bioreactor. Ethanol productivity from these substrates was enhanced by creating more available space between fiber discs to facilitate removal of evolved CO_2 entrapped among the fiber discs. Glucose and sucrose at about 55 g/l were fermented in 1.6 h with about 90% substrate utilization and waste water from corn wet milling process with 115 g/l sugars was fermented completely in 2.5 h by S. cerevisiae loaded at 56 g/l cell density. Cane molasses containing 195 g/l total sugars was fermented in 3.6 h (90% substrate utilization) by S. cerevisiae with a maximum end product of 83 g/l ethanol (10.6% by volume) and an ethanol productivity o 23 g/l/h. The bioreactor was run continuously with cane molasses containing 195 g/l total sugars at a fixed flow rate of 0.55 l/h (dilution rate=0.27/h) for 15 days, during which there was a loss of 8% of the original activity. The half life of the bioreactor was estimated to be about 98 days. The performance of P., stipitis (R) was found to be slightly inferior to S. cerevisiae. The merits and the potentals of this fermenter for ethanol production is discussed. 22 refs., 3 figs., 3 tabs.

44844 (MWL–8703, pp. 28) **Isoenzyme and protein patterns of pentose-fermenting yeasts after adaptation to wood hydrolysates.** Jeng, R.S. (Univ. of Toronto, ON, Canada); Yu, S.; Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Soluble proteins were extracted from the vegetative cells of two pentose-fermenting yeasts, Candida shehatae and pichia stipitis, and their adapted strains, C. chehatae R and P. stipitis R respectively. Isoenzyme patterns, protein patterns and two-dimensional polypeptide mapping of these four strains were compared by polyacrylamide gel electrophoresis. The two adapted strains showed great similarity in two-dimensional polypeptide mapping, the pattern of sodium dodecyl sulfate-polyacrylamide gel electrophoresis, isoelectrofocusing, and isoenzymes. The two starting strains of these yeasts had their own characteristic electrophoretic patterns. The adapted strains showed the presence of 3 alcohol dehydrogenase isoenzymes compared to 1 for the starting strains, as well as much higher activity of malate dehydrogenase, isocitrate dehydrogenase, glucose-6-phosphate dehydrogenase and 6-phosphogluconate dehydrogenase, which further formation of pyruvate and ethanol. 27 refs., 5 figs.

44845 (MWL–8703, pp. 18) **Fermentation to ethanol of pentose-containing spent sulphite liquor.** Yu, S. (Univ. of Toronto, ON (Canada)); Wayman, M.; Parekh, S. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The use of Candida shehatae ATCC 22984 which ferments both pentoses and hexoses for ethanolic fermentation of spent sulfite liquors (SSL) has shown highly favorable results in terms of increased alcohol production and improved sugar removal. Experiments have shown that fermentation is rapid and efficient when the SSL is steam stripped to raise pH by at least 1 unit, when using high cell concentrations of 10 g/l and above, and when the yeast is recycled through successive fermentations many times. A small, controlled amount of air is necessary in these fermentations to ensure good fermentation of pentoses. C. shehatae (R) is tolerant of sugar concentrations to at least 250 g/l and of alcohol concentations to about 100 g/l. Complete and efficient fermenation of such highly concentrated sugar solutions required low temperature vacuum distillation of the alcohol. Under some circumstances, xylitol, mannitol and sorbitol are formed in low concentrations as by-products of fermentation of SSL. Enzyme saccharification of the sugar oligomers in SSL results in higher alcohol yields. C. shehatae (R) is able to ferment both hexoses and pentoses simultaneously, efficiently and rapidly. Present indications are that is is well suited to industrial operations wherever hexoses and pentoses are both to be fermented to ethanol, for example, in wood hydrolysates. 4 refs., 6 tabs.

44846 (MWL–8703, pp. 4) **Ethanol and sugar tolerance of candida shehatae.** Wayman, M. (Univ. of Toronto, ON (Canada)); Parekh, S. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Candida shehatae ATCC 22984 fermented solutions of up to 260 g/l sugars derived by hydrolysis of whole barley. These solutions contained hexose:pentose 70:30, the hexose being mainly glucose from the barley starch and the pentose being mainly xylose. At sugar concentrations of 180 g/l, fermentation was complete in 72 h, yielding 84 g/l ethanol, 0.47 g ethanol/g sugar. At 260 g/l, fermentation ceased when ethanol concentration reached 100 g/l, but resumed when the ethanol was removed by vacuum distillation, to yield finally 0.50 g ethanol/g sugar. 6 refs., 1 fig., 2 tabs.

44847 (MWL–8703, pp. 6) **Fermentation of spent suphite liquor to butanol and ethanol.** Yu, S. (Univ. of Toronto, ON (Canada)); Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

With the objective of achieving complete desugaring ahead of vanillin production, spent sulphite liquor (SSL) has been fermented to butunol by two strains of Clostridium and to ethanol by Candida shehatae, these micro-organisms being chosen for their ability to ferment both hexoses and pentoses. For butanol fermentation, SSl

was first steam stripped to pH 4.5 or higher in order to remove more than 90% of volatile inhibitors present in the liquor. Cl. butyricum ATCC 8260 and Cl. acetobutylicum NRRL 594 were successfully adapted to SSl by a series of subculturing transfers. While sugar consumptions (73-84%) and solvent production (0.18-0.25 g/g of initial sugar) were lower than that experienced with pure sugars (96% and 0.35 g/g of sugar, respectively), this fermentation was more complete than industrial ethanol fermentation by Saccharomyces cerevisiae. For ethanol fermentation C. shehatae ATCC 22984 was able to ferment SSL steam stripped from pH 2 to pH 3 to 3.4 without adaptation. By recycling the yeast in SSL many times, and by the use of high cell concentration, 13-19 g/L, fermentation was complete in 12 to 18 h, 95.5% of the total sugars present were consumed and efficiency was 0.46 g ethanol/g initial sugar concentration, compared to 65.4% sugar removal and 0.35 g ethanol/g initial sugar concentration with S. cerevisiae. Thus 33% more alcohol was produced by this yeast, and 46% more sugar was removed from SSL. 12 refs., 3 figs.

44848 (MWL–8703, pp. 22) **Production of acetone-butanol by extractive fermentation using dibutylphthalate as extractant.** Wayman, M. (Univ. of Toronto, ON (Canada)); Parekh, R. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Extractive fermentation of glucose-xylose mixtures and hydrolysates of lignocellulosics to acetone-butanol solvents were studied and compared with similar fermentations in the absence of extractant. The extractant selected for this research was dibutylphtalate which, in addition to having satisfactory physical properties for this purpose, is non-toxic and mildly stimulating to the growth fo the organism used, Clostridium acetobutylicum P262. Sugar concentrations mainly in the range of 80 to 100 g/l resulted in solvent concentrations of 28 to 30 g/l in 24 h extractive fermentations. Conversion factors of 0.33 to 0.37 g solvents/g sugar consumed were obtained. Rapid fermentation was achieved by high cell concentrations and cell recycle from each 24 h fermentation to the succeeding similar 24 h fermentation. Somewhat higher nutrients were also helpful. By this means, 255 l of acetone-butanol solvents were obtained per tonne of aspen wood, 298 l per tonne of pine and 283 l per tonne of corn stover. Such high product yields from inexpensive substrates offer the prospect of economic viability for the process. 19 refs., 3 figs., 1 tab.

44849 (MWL–8703, pp. 25) **Acid hydrolysis of lignocellulosics for alcohol production.** Assarsson, P. (Univ. of Toronto, ON (Canada)); Holysh, M.; Tallevi, A.; Wayman, M.; Parekh, S. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Slurries of agricultural wastes have been successfully prehydrolyzed and delignified using a pilot plant continuous plug flow reactor. Conditions established for essentially complete recovery of the hemicellulose component of corn cobs as the monosaccharides xylose and arabinose are approximately 7 minutes at 150°C with 0.5% HCl. Delignification of prehydrolysed corn cobs with 4% alkali at 167°C for 8 minutes resulted in more than 99% of the lignin being removed. Of the lignin removed, about 80% was recoverable. The remainder maintained its solubility even after acidification. The yeast Candida shehatae successfully fermented pure xylose and glucose but was not as effective at fermenting corn cob prehydrolyzates. Single pass hydrolysis of Alpha Floc has thus far resulted in a maximum glucose yield of 45%. However, initial hydrolysis of prehydrolysed and delignified corn cobs has resulted in a 60% glucose yield. Preliminary cost estimates indicate that under certain assumptions a 40 million l/yr plant can produce ethanol at a selling price of $0.45/l. 6 figs., 4 tabs.

44850 (MWL–8703, pp. 4) **Hydrolysis of biomass by sulphur dioxide. 2. Recalculation of ethanol yields including pentose fermentation.** Wayman, M. (Univ. of Toronto, ON (Canada)). Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Yields of ethanol calculated from the sugars obtained by two-stage SO_2-catalysed hydrolysis of biomass are now much higher than reported in a 1984 investigation as a result of successful rapid and efficient fermentation of xylose to ethanol by R strains of Candida shehatae and Pichia stipidis. Increases in ethanol yields due to xylose fermentation were calculated, based upon the quantities of hexose and pentose sugars obtained upon SO_2 hydrolysis, to be: for pine wood 27.8%, aspen 42.7%, bagasse 52.6%, corn cobs 65.8% and wheat straw 64.6%. Ethanol yields calculated from sugar yields were 405 to 433 l/tonne from wheat straw, pine and corn cobs, 356 from aspen and 312 from bagasse. 3 refs., 1 tab.

44851 (MWL–8703, pp. 5) **A new continuous dynamic immobilized cell fermenter.** Parekh, S.R. (Univ. of Toronto, ON (Canada)); Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Yeast cells, immobilized on rotating disks in a horizontal cylindrical continuous bioreactor have been shown to ferment sugar solutions of 100 to 200 g/L rapidly and efficiently. In such a bioreactor, residence times for glucose, sucrose and cane molasses are 1.6, 1.6 and 3.6 hours respectively, and sugar utilization is 90% with ordinary bakers' yeast. Pichia stipitis R in this bioreactor can ferment spent sulphite liquor containing both pentoses and hexoses efficiently and rapidly. 22 refs., 3 figs., 2 tabs.

44852 (MWL–8703, pp. 4) **SO_2 pretreatment for high yield ethanol production.** Wayman, M. (Univ. of Toronto, ON (Canada)); Parekh, S.R.; Seagrave, C. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN

Pine sawmill waste, aspen chips, and corn stover were prehydrolyzed with SO_2 followed by direct enzyme saccharification. Comparison with autohydrolysis alone reveals that the SO_2 pretreatment improved yields of hemicellulose sugars to near theoretical levels. The solution of hexoses and pentoses so obtained were fermented by Pichia stipitis R, yielding 372, 346, and 388 liters of ethanol per tonne, respectively. A large scale run, 1.5 tonnes per hour, with coniferous wood gave excellent results. The process, which combines flexibility of feedstock with robust hydrolysis and fermentation, lends itself to large-scale industrial application if the economics of enzyme saccharification can be brought into an acceptable range. 13 figs., 4 tabs.

44853 (MWL–8703, pp. 11) **Butanol production by extractive fermentation using fluorocarbons.** Wayman, M. (Univ. of Toronto, ON (Canada)); Husted, G.R.; Santangelo, J.D.; Levy, S. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1987. (CONF-8405450–: 6. international symposium on alcohol fuels technology, 21-25 May 1984;

MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper describes a new system for producing butanol by extractive fermentation. While sugar or starch raw materials may be used as substrates, the butanol-forming organism is particularly interesting in its ability to ferment pentoses, enabling good yields of butanol from hydrolysates of pentose-rich feedstocks such as agricultural crop residues, bagasse and deciduous woods such as poplar and willow. The new process is designed to overcome product inhibition, a major handicap to commercial exploitation of the conventional butanol-acetone-ethanol process. Butanol concentrations over 1.5 to 2% have inhibited fermentation. In the process reported, butanol is extracted from the beer by fluorocarbons, especially Freon 11, which enables butanol production to proceed. Fluorocarbons are particularly attractive extractants because of very low heats of vaporization, enabling the recovery of both extractant and product at low cost. This process is suitable for conventional batch fermentation; and other process models are presented, including continuous tower fermentations with immobilized cells, and two-stage fermentations with butyric acid formers in the first stage and butanol formers in the second stage. 15 refs., 2 figs.

44854 (MWL–8703, pp. 4) **SO_2-catalysed prehydrolysis of coniferous wood for ethanol production.** Wayman, M. (Univ. of Toronto, ON (Canada)); Parekh, S.; Chornet, E.; Overend, R.P. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1986. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper reports studies of large scale, 1500 kg/h, SO_2-catalysed prehydrolysis of coniferous wood chips, samples then being hydrolyzed by a wood-saccharifying enzyme system followed by fermentation to ethanol in the laboratory. Hemicellulose hydrolysis using SO_2 catalyst (prehydrolysis) was found to be more effective than steam alone (autohydrolysis). Prehydrolysis time was 2 min, with steam pressure at 175 to 250 psi, and SO_2 catalyst 2.0 to 2.6% on dry wood. The amount of sugars recovered upon enzyme saccharification of the prehydrolysed wood was about 70% of the weight of the wood. When these combined hemicellulose and cellulose sugars were fermented by a pentose-fermenting strain of yeast, Pichia stipitis R, 372 ethanol/tonne of (dry) wood was obtained. 4 refs., 2 tabs

44855 (MWL–8703, pp. 4) **Fermentation of cellobiose and wood sugars to ethanol by candida shehatae and pichia stipitis.** Parekh, S. (Univ. of Toronto, ON (Canada)); Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1986. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Three pentose fermenting yeast strains of Candida shehatae and three of Pichia stipitis were examined for their ability to produce ethanol from cellobiose and from sugars liberated by hydrolysis of lignocellulosic biomass. All of the Pichia strains tested produced some fermentation of 25 g/l cellobiose within 48 hours. This yeast also produced considerably more ethanol from the wood sugar mixture. 11 refs., 2 tabs.

44856 (MWL–8703, pp. 5) **Adaptation of Candida shehatae and Pichia stipitis to wood hydrolysates for increased ethanol production.** Parekh, S.R. (Univ. of Toronto, ON (Canada)); Yu, S.; Wayman, M. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1986. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Candia shehatae ATCC 22984 and Pichia stipitis CBS 5776 were tested for ethanol production from xylose, glucose-xylose mixtures, and aspen wood total hydrolysates. Adaptation of these yeasts to wood hydrolysate solutions by recycling resulted in improved substrate utilization and ethanol production. Compared to the non-adapted cultures, recycled C. shehatae and P. stipitis in aspen hydrolysate increased g ethanol/g sugar consumed from 0.39 and 0.41 to 0.45 and 0.47; while ethanol production from a 70:30 glucose-xylose solution (total sugars 140 g/l) was 45 g/l in 24 h and 60 g/l in 72 h with the adapted yeasts compared to 15 g/l and 28 g/l in the same times with the parent strains. 11 refs., 1 fig., 1 tab.

44857 (MWL–8703, pp. 6) **Acetone-butanol fermentation of xylose and sugar mixtures.** Wayman, M. (Univ. of Toronto, ON (Canada)); Yu, S. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1985. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Three strains of Clostridium acetobutylicum and one of Cl. butyricum have been tested for their ability to ferment xylose to butanol. ATCC 824 and NRRL 527 cultures produced 0.28 g solvents/g xylose, while ATCC 8260 or NRRL 594 acted upon xylose for 12 to 20 h, followed by NRRL 527 for a total of 3 days, yields of solvent were better, 0.32 g/g xylose. Upon fermenting a mixture of sugars (glucose and xylose) simulating sulphite waste liquor, 0.36 g solvents/g sugar were obtained. Sugar consumption in both cases was about 96%. 11 refs., 3 tabs.

44858 (MWL–8703, pp. 9) **Hydrolysis of biomass by sulphur dioxide.** Wayman, M. (Univ. of Toronto, ON, Canada); Tallevi, A.; Windsborrow, B. Quebec Ministere de l'Energie et des Ressources, PQ (Canada). Bureau des Economies d'Energie. 1984. (MICROLOG–89-00772). In *Develop a novel biomass catalysed pretreatment and hydrolysis for cosolvent fuel butanol and ethanol fermentation. Volume 2.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Results of hydrolysis of several types of cellulosic biomass, namely pine sawmill residues, aspen poplar chips, sugarcane bagasse, wheat straw and corn cobs, are presented in which sulphur dioxide was the hydrolysis catalyst. Hemicellulose was first hydrolysed at 150°C, and following removal of hemicellulose sugars by water washing, residual cellulose was hydrolysed at 190°C, using SO_2 in both stages. Hemicellulose hydrolysis with SO_2 catalyst (prehydrolysis) was compared with steam hydrolysis in the absence of added catalyst (autohydrolysis) and poplar. In SO_2 hydrolysis of these five boimass species, recovery of hemicellulose sugars was essentially quantitative, while cellulose hydrolysis varied from 54.5% for wheat straw to 84.3% for pine. Some economic consequences of this process are discussed. Yields of ethanol, butanol and furfural from these raw materials were estimated. 10 refs., 5 tabs.

44859 **Equilibria within the $Ru_3(CO)_{12}$/halide system.** Han, S.H. (Pennsylvania State Univ., University Park (USA)); Geoffroy, G.L.; Dombek, B.D.; Rheingold, A.L. *Inorganic Chemistry (USA),* 27(24): 4355-4361 (30 Nov 1988).

A comprehensive study of the $Ru_3(CO)_{12}$/halide system was undertaken, and the report of the results are presented herein. Various equilibria that are present in the $Ru_3(CO)_{12}$/halide system are discussed. New compounds described in this study are clusters $[Ru_4(\mu_2\text{-}X)(CO)_{12}]^-$ and $[Ru_3(\mu_3\text{-}I)(CO)_9]^-$, and the latter compound has been characterized by x-ray diffraction study. The

reactions of $Ru_3(CO)_{12}$ and $Fe_3(CO)_{12}$ with iodide under H_2/CO atmospheres are reported. 28 refs., 3 figs., 4 tabs.

0904 Solid Waste and Wood Fuels

Refer also to citation(s) 44408, 44905, 44992, 45004, 45176, 45195, 45307, 45308, 45309, 45751, 45877

44860 (CNBA–8711) **Wood-fired boiler workshop.** Canada/New Brunswick Agreement on Conservation and Alternative Energy Activities, Fredericton, NB (Canada). 1987. 79p. (CONF-8711323–: Wood-fired boiler workshop, 24-25 Nov 1987; MICROLOG–89-02879). Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This is the second in a series of workshops devoted to improved efficiency in wood-fired boilers. Its purpose is twofold: to provide an opportunity to present solutions to individual or collective problems and to lead to greater economy in energy conversion based on wood. The workshop proceedings also contain summaries of discussions on the presentations and accounts of visits to wood burning installations: Brookdale Nurseries Ltd (treated in more detail in an appendix), Miramichi Pulp and Paper Inc. sawmill, Hotel Dieu Hospital, and N.B. Power Generating Station (coal- and heavy oil-fired, but wood residue is to be tested in 1988). Biomass energy values and conversion factors are given in an appendix. Separate abstracts have been prepared for four papers.

44861 (CNBA–8711, pp. 5) **The combustion cell and boiler.** Shuve, E.A. (Atlantic Heating Plant Specialties, Inc.). Canada/New Brunswick Agreement on Conservation and Alternative Energy Activities, Fredericton, NB (Canada). 1987. (CONF-8711323–: Wood-fired boiler workshop, 24-25 Nov 1987; MICROLOG–89-02879). In *Wood-fired boiler workshop.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper concerns wood combustion chambers and boilers. It was discovered some time ago that, instead of burning wood in a single steel drum, one could gain more heat by placing two horizontal steel drums, one on top of the other, with a pipe connecting the two drums. This was the beginning of the combustion cell and heat exchanger. In most of the wood burning applications, a fire tube boiler is used, and the boiler that appears best suited to wood firing is the fire box type of unit. For most wood burning plants of today's design, a figure of 6 to 7 ft^2 per boiler hp has been found to be adequate. The main points in selecting a boiler or heat exchanger are that the unit is of adequate size, that it has sufficient heating surface, and that it has been approved to operate at the required pressure. The boiler must also be registered in the province in which it is to be installed. The boiler must be fitted with the proper trim to meet the applicable codes, and to perform the functions required for its safe operation. The access platforms and the care and maintenance of the boiler are most important. A typical combustion cell is described. In the pile of burning wood, all the burning takes place in the top 2 in., although the pile may be 2 or 3 ft deep. Fans cause the cell to operate under a regulations require negative pressure. Combustion cells, in most installations, are fitted with thermometers; the Dept. of Labor regulations require that a means be provided to extinguish the fire in case of a low water feed to the boiler. According to this paper, the more simple a wood burning system is kept, the better it works and the fewer failures there are.

44862 (CNBA–8711, pp. 18) **An overview of control systems for wood fired boilers.** Bleakney, M.R. (Solid Energy Systems Ltd.). Canada/New Brunswick Agreement on Conservation and Alternative Energy Activities, Fredericton, NB (Canada). 1987. (CONF-8711323–: Wood-fired boiler workshop, 24-25 Nov 1987; MICROLOG–89-02879). In *Wood-fired boiler workshop.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A modern automated control system should reduce labor requirements, undertake actions or measurements beyond human capability or acuity, and make logical decisions rapidly and consistently. On the other hand, an automated control system will be less flexible and adaptable than humans, intolerant of design errors, dependent on human intervention if incorrectly programmed, and incapable of learning from past events or of predicting future ones. The purpose of the control system for a wood-fired boiler is to satisfy the demand for boiler output by controlling the combustion process and the fuel flow to the combustor. A rarer, though no less important purpose of the system is to detect any problems in the fuel flow, combustion process, or safe operation of the boiler, and to take appropriate action. This paper discusses the three stages of the combustion process and its control, the control of fuel handling, safety controls, and the conditions that should determine low-fire operation or emergency boiler shutdown. Programmable controllers based on microprocessors are discussed, including the Allen-Bradley PLC4, the SLC 100, and the GE series 1. Points to keep in mind when designing or selecting a control system are listed.

44863 (CNBA–8711, pp. 10) **Wood: a fuel for the future in New Brunswick.** Canada/New Brunswick Agreement on Conservation and Alternative Energy Activities, Fredericton, NB (Canada). 1987. (CONF-8711323–: Wood-fired boiler workshop, 24-25 Nov 1987; MICROLOG–89-02879). In *Wood-fired boiler workshop.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Wood has historically been important as a source of energy in New Brunswick, and its use as a fuel has more than doubled since 1980. It can be a difficult material to handle, but it is seen to be a good fuel with very little environmental impact compared to most other fuels in common use in that province. Modern wood burning equipment can provide reliable performance without production of harmful stack pollutants or toxic ash products. Until now, most wood burning installations have used wood processing residues as fuel. Approximately 90% of this material is now committed for use as fuel or other purposes, and expansion of wood burning capacity to a great extent will require the development of new fuel sources. The most likely source of large quantities of wood fuel in the future will be the salvage of harvest residues that are currently left as waste in the forest. Harvest residues are a vast, nearly untapped energy resource that can be processed into wood fuel, using existing techniques, at reasonable cost. As oil prices climb, the wood fuel resource in New Brunswick will undoubtedly be developed to its economic potential to replace expensive oil from foreign suppliers with a renewable, locally produced fuel while ensuring the maximum economic and silvicultural benefit to the forest product industries.

44864 (NBNRE–8810) **Wood energy symposium proceedings.** New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. 222p. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Topics covered in this symposium include the economics, forestry, and the technology of wood-burning installations. In economics, the subjects were the future of energy prices, the resource assessment of and the market for wood energy in Canada, the socio-economic impacts of wood energy, and the financing of energy projects. In forestry, the subjects were optimum forest management strategy, wood harvesting, chipping and haulage, and wood fuel prices. In the technology of wood-burning installations, the subjects were existing wood-fired boilers and power plants (including the 7.2 MW power plant in Chapleau, Ontario), wood handling and feeding systems, and pollution abatement. Separate abstracts have been prepared for 11 papers.

44865 (NBNRE–8810, pp. 20) **Small-medium fuelwood chipping.** Folkema, M.P. (Forest Engineering Inst. of Canada). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper results from a series of visits to small or medium scale fuel wood chipping operations in Maine and Atlantic Canada, with the purpose of providing logging entrepreneurs with the information needed to produce fuel wood chips efficiently and at the lowest possible cost. The first step in determining the feasibility of an operation is to analyze the potential market and to evaluate the transportation costs. The paper discusses the choice of a whole-tree chipper, felling methods, chip loading and hauling, wood weight measurement, chip unloading and chip storage. In the state of Maine, the 1988 price paid for whole-tree chips delivered to cogeneration-type boilers from large scale chipping operations was about $(Canadian) 23/green ton ; the average haul distance was about 30 km, the maximum distance, 40 or 50 km. In Atlantic Canada, the price was about the same (23$ to 25$) if the haul distance was the same; the prices from small scale chipping operations were higher, up to 35$. Fuel wood chipping should normally be part of an integrated logging operation, producing a variety of products such as sawlogs, pulpwood or pulp chips, which usually have a higher value, as well as fuel chips. There are many aspects of small or medium fuel wood chipping operations that can be improved; the cost of fuel wood chips can be reduced by increasing chipper utilization. 8 refs., 1 tab.

44866 (NBNRE–8810, pp. 13) **Emission test results.** Fraser, K.T. (Research and Productivity Council). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper presents the results of emissions testing that was carried out at the Research and Productivity Council of Canada over a period of years. Three types of combustion systems have been selected for discussion here: a basic wood stove, a stokes-fed boiler unit and a gravity-fed boiler unit. Many fuel types were examined, including Douglas fir 2x4 in., maple chunk wood, hardwood and softwood chips, sawdust and peat logs. During the tests, the flue gas was monitored continuously for the concentrations of oxygen, carbon dioxide and carbon monoxide as well as for temperature; the sampling of particulates was carried out in a dilution tunnel. It appeared that the moisture content of the fuel being burnt had a significant impact on the levels of emissions generated; as the moisture content rose, generally speaking, so did the emissions. All other parameters being equal, fuel in the particulate or residue form produced lower levels of emissions than the fuel in the chunk form. The design of the combustion unit was also of great importance in determining the emissions which were generated during its operation; a simple wood stove, particularly when operated in air-starved manner that is common practice, cannot generally perform as a properly designed boiler or furnace. These results point the way for further investigation. 7 figs.

44867 (NBNRE–8810, pp. 19) **Design and operation of a 7.2 MW wood waste co-generation plant. A case history.** Golobic, P. (Ontario Ministry of Energy, ON, Canada); Sherville, P.; Ivey, W.P. New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Chapleau, Ontario, co-generating plant is a privately owned, state-of-the-art, 7.2 MW wood fired thermal electric generating facility. By safely and cleanly disposing of 120,000 tons/y of sawmill waste produced by the 3 Chapleau sawmills, this plant is able to supply in electric power the town of Chapleau and most of the surrounding area as well as to supply steam to Chapleau Forest Products Ltd. The paper describes the history of the project, the major equipment (steam generator, wood handling system, spray pond, electrical substation, boiler room equipment, turbine, generator, and control room), and the commissioning of the power plant. Since the commercial start-up of the cogenerations plant in February 1987, plant availabitly has exceeded 90%; the average capacity factor was 74.3 %; electricity production from February 1 to November 30, 1987 was 34.4 GWh and 8,517 tons of low-pressure steam were delivered to the sawmill. The paper discusses the operational experience of the plant. Chapleau Co-Generation Ltd is the first wood-fired cogeneration facility in Canada operating as an independent business venture. Given the relatively low avoided cost of electrical energy in the province of Ontario, and the consequently low energy buy-back rate, the economics of this operation are marginal at present; commercial viability is achieved by steamlining all aspects of the operation as much as possible. All plant wastes, including water treatment wastes, blowdowns, and floor drains, are evaporated in the wet scrubber. The concept of Chapleau is now being replicated; 9 MW and 10.8 MW plants are scheduled for operation in 1989, and 2 other sites are undergoing feasibility studies.

44868 (NBNRE–8810, pp. 20) **Current activity in wood chip combustion systems in the Atlantic region.** Brandon, R.J. (P.E.I. Energy Corp., PE, Canada); Owens, E.T.; Drover, J.; Hayes, B. New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper reviews the activity in the use of wood chip fuel in medium-sized installations that installed heating systems from 200 kw to 20 mw. The large pulp and paper residue fuel boilers have been excluded because they form a distinct market segments. Systems installed in the 4 atlantic provinces of Canada are presented. The trends in technology for combustion systems and electrical power production are discussed, as are the capital costs, fuel costs and environmental aspects of wood energy. A list of the 4 suppliers of medium-sized wood combustion equipment in Canada is given. In conclusion, this paper shows that improvements have been made in the installed capital cost for wood-fired equipment. Future opportunities will depend on expectations of future oil prices. However, new opportunities exist in electric power generation and cogeneration; also, there exists some economic opportunities where residue fuel is available at reasonable cost. It is recommended that government should take into account the environmental advantage of wood fuels by subsidizing their cost. 1 fig., 6 tabs.

44869 (NEI-DK–181) **Preliminary processing of biomass-derived fuels. On-site dual-purpose power plants.** Krueger (I.) A/S, Copenhagen (Denmark). Feb 1989. 115p. (In Danish). Order Number DE89914637/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

In connection with the increasing number of on-site dual-purpose power plants to be found in Denmark today there is a growing need for informaion on the preliminary management of biomassderived fuels. The report deals, in this respect, with straw, wood chips, municipal wastes, and sludge wastes, also those produced by the food processing industry. Stoking techniques and equipment for the most generally used types of boilers are dealt with, and the production processes of biomass-derived fuels are described right from the beginning. Characteristics of the different types of these fuels, and evaluations of resources and availability, are given. The demands which possible future development in this area may bring are

touched upon and seven aspects concerned with environmental impacts asociated with the preliminary treatment of biomass-derived fuels are illuminated. (AB) 21 refs.

44870 (OY/PSTL-RR–93) **Manufacture and use of tar.** Paajala, J.; Jokivartio, T. Oulu Univ. (Finland). Research Inst. of Northern Finland. 1989. 102p. (In Finnish). Order Number DE89787749/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

A study is made of the stages in the history of the manufacturing of tar in Finland and its economic importance. The most important quality for the wood used in tar manufacture is its resin content. Most resin is found in pine stumps. Several phases can be distingished in the destructive distillation of wood (pyrolysis), from evaporation of the water to decomposition of the wood into tar and other components. Destructive distillation can be divided into direct and indirect methods depending on the manner of heating. In the direct method the heat is produced by burning part of the wood to be reduced to charcoal. This is the principle of the tar pit and tar works. In the indirect method pyrolysis takes place in a retort. There are several variations on this method, some examples of which are presented here. Tar consists of numerous compounds which can be separated by distillation. The resulting substances can be used as industrial raw materials, but this presupposes the production of tar on a large scale. Tar has traditionally fulfilled many purposes. Nowadays it is mainly used for wood preservation. Rough production costs are calculated for pit and retort tar. The quantities of wood tar produced and the amounts exported and imported are presented based on official statistics. An appendix is provided containing a catalogue of tar manufacturers, users and experts. In addition to the literature referred to in this paper, a bibliography is provided of other lierature on this topic.

44871 (SJF-Orientering–57) **Dust emission from straw fueled plants.** Thellesen, H.Z. Statens Jordbrugstekniske Forsoeg, Horsens (Denmark). Afd. for Driftsteknik og Energi. Sep 1988. 10p. (In Danish). Order Number DE89914638/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

Dust emission from straw-fueled power plants is significant and the authorities are concerned that it could present a considerable public health hazard as the smallest dust particles float in the air for a long time and do not get filtered properly in the human nose and pharynx. Thus they pass directly into the lungs. It was discovered that dust emission can vary from 160mg to 2300mg per normal-m3 dry smoke. The quality of the straw itself was most decisive in regard to variations in the amount of emission and it was found that rain-washed straw produced less emission. Up to 67% potassium chloride and a total amount of up to 96% water-soluble matter was found in dust emission from straw-fueling and it is suggested that this could mean that straw used as fuel presents a lesser threat to the environment than other fuels. (AB).

44872 (STEV-TB–89-3) **Test and evaluation of some binders used in ash granulation.** Falk, T. Statens Energiverk, Stockholm (Sweden). 11 Apr 1989. 20p. (In Swedish). Order Number DE89914796/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The tests show that the delivered, not premoistened ash has a strong natural binding quality which does not need any other additions to give strong and durable granules after a hardening period of 3 to 7 days. This property has not been noticed earlier, but explains why very small amounts of binders have given strong granules in earlier tests. Wetting of the ash starts the hardening reaction which is not reversible. In case of need for a complementary binder, ordinary cement powder shows good results while gluing binders requesting drying is not suitable. Budget costs for some binders and additives are given as well as drying costs for drying to two levels. Recommendations for a process solution for an ash granulating plant in which the natural binding quality is utilized are given in the report. (author).

44873 (SV-US–1989-11) **Solid fuel combustion at Hammarstrand and Stugun, and LPG combustion at Hammarstrand.** Lindblom, A. Swedish State Power Board, Vaellingby (Sweden). 10 Feb 1989. 65p. (In Swedish). Order Number DE89914803/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The report describes the fuel choice in two small heating plants, Hammarstrand 1.0 MW and Stugun 0.5 MW. The Hammarstrand plant was destroyed by fire in 1987. In connection with the reconstruction, the bases for the entire enterprises was studied. It was decided to burn wood chips at Hammarstrand and briquets at Stugun. For load adjustment and peak load, LPG-burning appliances were installed. Access to cheap fuel of uniform and good quality within an acceptable transport distance determines alone whether the venture is economically justified or not. There is no room for planning misses, particularly in a situation where domestic fuels have to compete with established and simpler fuels, i.e. LPG and fuel oil.

44874 (VTT-TIED–863) **Particle size of fuel chips made by landing chippers.** Seppaenen, V. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1988. 67p. (In Finnish). Order Number DE89787758/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Chippers for fuel chip production were studied especially concentrating on long pieces. Two disc chippers, one cone screw chipper and two drum chippers were studied. How the tree to be chipped, the dullness of the blades and the lowering of the rotational speed of the chipper influence the particle size of fuel chips was studied. For analysis of particle size a 2-phase screening was developed, which made it possible to use large samples (6 chip-m^3). In this way it was possible to analyse the small number of long sticks. The chips made by large drum chipper included the smallest proportion of long sticks. The chips made by small disk chipper included most of the long sticks. The proportion of finess was the largest on large drum chipper and the smallest on small disc chipper. In different tests the percentage of over 200 mm long sticks was 0-0.4%. The differences between chippers are clear, but the differences were smaller han differences between tests made with different tree materials. When the blades became dull the proportion of over 200 mm pieces increased considerably compared with the chips made by a chipper having sharp blades. This clearly shows that it is possible to influence the qualiy of chips by the choice of the chipper, but it is impossible to produce good chips by dull blades, even though the chipper is good.

44875 (VTT-TUTK–591) **Continuum-mechanical derivation of the conservation equations for the pyrolysis and combustion of wood.** Wichman, I. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1989. 49p. Order Number DE89787768/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The equations for conservation of mass, species and energy for both the gas and solid phases are averaged over a characteristic wood volume element during pyrolysis or combustion. The presence of a pure liquid phase in wood is neglected in this study. The wood sample is assumed to obey the continuum hypothesis once phase averaging is completed. Heat conduction, adsorption (and desorption) and chemical reaction occur at the interface between gas and solid. Overall conservation equations are written for mass and energy; the species equations for the two phases are kept separate. Integration of the momentum for the gas phase produces and expression for the velocity field in the sample. Simplified equations are written for two limiting cases of significant practical interest.

13 HYDRO ENERGY

1301 Resources and Availability

44876 (EC/IWD–1987A) **Alberta historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 67p. (In English and French). (MICROLOG–87-03480). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in Alberta. Historical data are included as far back as 1915, when they were collected as part of irrigation surveys. Subsequent hydrometric surveys were conducted by the Dominion Water Power Branch and

the Water Survey of Canada. Data have also been contributed by other organizations, such as electric utilities. Descriptive information about the gauging stations is also included, such as location, type of gauge, drainage area, and whether the flow is natural or regulated.

44877 (EC/IWD–1987BC) **British Columbia historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 180p. (In English and French). (MICROLOG–87-02958). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in British Columbia. Historical data are provided as far back as 1912, when they were collected mainly for irrigation purposes. Later hydrometric surveys were conducted by the Dominion Water Power Branch and the Water Survey of Canada. Data have also been supplied by other organizations, such as electric utilities. Descriptive information about the gauging stations is also included, such as location, type of gauge, drainage area, and whether the flow is natural or regulated.

44878 (EC/IWD–1987YNT) **Yukon and Northwest Territories historical water levels summary, to 1985.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1987. 55p. (In English and French). (MICROLOG–87-02816). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in the Yukon and Northwest Territories. Some of the historical data go back as far as 1902 but it was not until 1944 that regular hydrometric surveys were performed, first by the Dominion Water and Power Bureau. Descriptive information about the gauging station is also included, such as location, type of gauge, and whether the flow is natural or regulated.

44879 (EC/IWD–1988A) **Alberta historical water levels summary, to 1987.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1988. 70p. (In English and French). (MICROLOG–89-02194). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in Alberta. Historical data are included as far back as 1915, when they were collected as part of irrigation surveys. Subsequent hydrometric surveys were conducted by the Dominion Water Power Branch and the Water Survey of Canada. Data have also been contributed by other organizations, such as electric utilities. Descriptive information about the gauging stations is also included, such as location, type of gauge, drainage area, and whether the flow is natural or regulated.

44880 (EC/IWD–1988YNT) **Yukon and Northwest Territories historical water levels summary, to 1987.** Environment Canada, Ottawa, ON (Canada). Inland Waters Directorate. 1988. VP (In English and French). (MICROLOG–89-02335). Available from Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A summary is presented of monthly and annual mean water levels, and annual extremes of water levels, for lakes and rivers in the Yukon and Northwest Territories. Some of the historical data go back as far as 1902 but it was not until 1944 that regular hydrometric surveys were performed, first by the Dominion Water and Power Bureau. Descriptive information about the gauging station is also included, such as location, type of gauge, and whether the flow is natural or regulated.

44881 (VTT-TIED–926) **Ecological aspects of lake regulation in Northern Finland. Part 1. General results.** Alasaarela, E.; Hellsten, S.; Huusko, A.; Tikkanen, P. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1989. 60p. (In Finnish). Order Number DE89787755/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The ecological effects of lake regulation were investigated during years 1984-1987 in Northern Finland. The main research areas were the regulated Lake Ontojaervi and the non-regulated Lake Lentua. Fieldwork concentrated on different shore types in the littoral zone. The use of a shore type classification enabled the results to be generalized to other Northern lakes. The main fieldwork topics were macrophytes, zoobenthos and its use as fish food, and the larvae of the autumn-spawning fish species and all the factors affecting these. The results were then used to construct a general description of the effects of water level regulation on the whole Lake Ontojaervi ecosystem. This report describes the project, the areas studied and the results of the general research. The yearly amplitude in water level since permission was given for its regulation permission has been 4.4 metres. A difference of 3.1 metres was obtained between the highest and lowest water level during the period 1961-1986, whereas under natural conditions the difference would be only 0.6 metres after recalculating the water levels. Thus regulation has increased water level fluctuation by about to 2.5 metres. the water level during the ice-free period is an average of 0.8-1.5 m higher than in the natural state. Regulation did not have a great influence on water quality, although the discharge of cold surface water during the winter reduced the oxygen content in the lake and sharpened the stratification during the winter. The winter drop in water level also lowered the oxygen content in some restricted bays. Assessment of the full effect of regulation on oxygen content requires the use of an oxygen model. During the springtime there were no differences in water quality between Lake Ontojaervi and Lake Lentua.

1302 Site Geology and Meteorology

44882 (OH/RD–87-329-K) **Waba Dam. Phase 2, investigation laboratory testing report.** Cragg, C.B.H. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 99p. (MICROLOG–89-02616). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Results of lab oratory tests on clay fill used in the crest and berm of the Waba Dam plus samples of foundation soil are reported and compared with in situ test measurements and original design work. These result indicate that the soft clay layer beneath the dam is underlaid by more competent soil at a shallower depth than shown in the original design work. This finding could have a positive effect on settlement and stability analyses. Dynamic testing has found the soft clay to be resistant to liquefaction and post-seismic-event strength loss. Parameters are provided for static and dynamic stability analyses of the dam. 9 refs., 67 figs., 16 tabs.

44883 (OH/RD–88-6-K) **DeCew Falls GS [generating station]. Investigation of headpond dyke materials.** Cragg, C.B.H. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 64p. (MICROLOG–89-02606). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Historical records show that the DeCew Falls Generating Station dikes were originally constructed in 1895 and enlarged in the late 1940s. As soil property data from these times is insufficient for modern day stability analyses of the dikes, the soils encountered in nine (1986) piezometer holes were sampled and tested to provide data for future design reviews. The dikes generally consist of firm silty clay underlain by hard, silty clay till and limestone bedrock. Physical properties of the old and new dike fill are quite similar. Organic material and local zones of weaker soil were encountered between the dike fill and the foundation soil, and in the fill overlying the former waste weir structure. 5 refs., 41 figs., 14 tabs.

44884 (OH/RD–88-7-K) **Geotechnical investigation at DeCew Falls GS [generating station] Forebay dyke, summer 1987.** Vorauer, A. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 130p. (MICROLOG–89-02589). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An intensive geotechnical investigation of the Forebay dyke at the DeCew Falls Generating Station was undertaken in the summer of 1987. This report provides data collected during field and laboratory testing in support of the investigation. The field program included several dilatometer and piezocone soundings regularly spaced along the crest of the 4,000 ft-long dike. The laboratory program included standard geotechnical index tests and CIU (consolidated isotropically undrained) triaxial tests on undisturbed soil samples. 39 figs.

1303 Plant Design and Operation

44885 (SARE–M91-7-43-1989E) **Rendell Creek ranch community small hydro and load management system.** SAR Engineering, Vancouver, BC (Canada). 1988. 56p. (MICROLOG–89-03051). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A small, remote community in southern British Columbia was forced to install a small hydro-electric system to eliminate high diesel-fuel costs for generating electricity. Under the Remote Community Demonstration Program, Energy, Mines and Resources Canada contributed funding toward: a transmission line from the generator to a shingle mill, additional homes, and future irrigated pasture; and load management equipment to fully use the electricity during low-streamflow and power output. The load management equipment sequences the delivery of electricity to the various loads. During late summer (September) and mid winter (February), streamflow decreased substantially, yet the load management equipment, combine with conservation efforts to disconnect non-essential loads, enabled the community to still use the small hydro generator. The shingle mill was powered by the diesel generator during these times. During periods of medium streamflow, the mill was operated, while non-essential loads were shed automatically. At times of peak streamflow, April through July, all equipment could be operated. The system rated size is 150 kW; the peak output during 1987 was 70 kW while the peak hourly load was only 43 kW. The load management equipment operated successfully and the system saves an estimated $1000/month of diesel-fuel representing a 2 year payback for the small hydro system, and a line cost $10,000 and saved the installation of additional diesel generators at the other locations. The small hydro generator size could have been reduced by 25% to 35% by using load management techniques from the start. A smaller and easier to build system would have resulted. 15 refs., 5 tabs.

1305 Economics and Management

Refer also to citation(s) 44976

44886 (GRS–652) **Cost management in a sales economy. A study of cost disrepancies in governmental power development.** Midttun, A.; Riise, B.; Raaholt, M. Gruppen for Ressursstudier, Oslo (Norway). Feb 1986. 90p. (In Norwegian). Order Number DE89914747/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Cost development is an important topic in Norwegian energy policy due to new hydroelectric power resources are less economically profitable than before. Environmental protection contributes to increase costs. The report discusses the cost effects originating in planning, decision-making and project managing problems. During the 1970ties there were considerable cost disrepancies in governmental power development partly originating in the initial phases and in the political decision-making phase. Detailed studies are carried out. One of the main conclusions is that the cost develop- ment is closely connected to the political, economical and organi- zational complexity in the planning, decision-making and initiating system. The technological and geological uncertainty contributes. Project management factors contributing to cost disrepancies are discussed in some detail. Consequences of deviations particularly on energy policy are discussed. 1 appendix, 11 figures, 24 tables.

1306 Environmental Aspects

Refer also to citation(s) 44881, 46155

44887 (MNR/FB–88-13) **A report on the fisheries resources of the lower Nelson River and the impacts of hydroelectric development, 1987 data.** Swanson, G.M.; Kansas, K.R.; Remnant, R.A. Manitoba Dept. of Natural Resources, Winnipeg, MB (Canada). Fisheries Branch. 1988. 312p. (MICROLOG–89-02358). Available from Manitoba Natural Resources, Public Information Services, 1495 St. James St., PO Box 22, Winnipeg, MB, CAN R3H 0W9; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Research activities reviewed in this report are part of an ongoing effort to identify potential impacts and associated mitigative activities related to hydroelectric developments on the Nelson River in Manitoba. The response of brook trout to impoundment of portions of the Nelson River was studied by transferring a sample population of trout into the Long Spruce Reservoir-Kettle River system. A total of 50% of these trout remained in the reservoir/river system, indicating that brook trout are capable of overwintering in a reservoir. Flooded creek mouths were the preferred habitat. In a study of trout movements into and out of tributaries, it was noted that these streams served as a nursery habitat, and that spawning was closely related to the presence of ground water. These studies confirmed previous hypotheses regarding the need for fish passage facilities at certain stream crossings and the significance of ground water in the life history of Nelson River brook trout. An attempt to locate groundwater upwellings was partially successful. A correlation was noted between granular borrow sites (unconfined groundwater aquifers) and groundwater upwellings in streams. Recommendations are included to mitigate the impacts of aggregate borrow operations. Studies are also reported on lake sturgeon and the fisheries resources of Angling Lake (walleye and northern pike). 75 refs., 102 figs., 54 tabs.

14 SOLAR ENERGY

Refer also to citation(s) 45489, 45490

44888 (CONF-8806404–) **Efficient use of solar energy in solar heated swimming pools.** Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. 55p. (In German). Contract BMFT 03E-5369-A;BMFT 03E-8146-A;BMFT 03-8146-B. From Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988. Order Number DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The works reported on in these papers were supported by the Federal Ministry for Research and Technology (BMFT) and the European Community within the framework of various projects dealing with efficient use of energy in swimming-pool construction. Contents of the report: 1. Chances of solar energy in the Federal Republic of Germany. 2. Solar-heated swimming pools - experiences gathered in the EC-BMFT supported demonstration project 'Energy conserving methods in swimming-pool construction'. 3. Thermographic studies of large absorber fields in order to detect disturbances in the continuous flow. 4. The use of pool covers in the demonstration project (EC, BMFT). 5. Heat recovery in indoor swimming pools. 6. Experiences and results from the view point of the operator of a solar heated pool. 7. Addresses where to obtain information on the research project 'Energy conserving measures in swimming pools'. (BR).

1401 Resources and Availability

Refer also to citation(s) 45360

1403 Economics

44889 (NEI-DK–186) **Danish export of solar-heating technology. The market in the Sudan, Senegal and Kenya.** Esbensen og Korsgaard Raadgivende Civilingenioerer, Copenhagen (Denmark). Mar 1987. 98p. (In Danish). Order Number DE89914643/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

EFP-86.

Information on the potential market in the Sudan, Senegal and Kenya for Danish manufactured solar collectors. Descriptions of situations in these countries where solar energy might be utilized, and information about toll and tariffs, are offered. Moreover, information about the World Bank's solar heating projects in each of these countries is given. (AB).

1405 Solar Energy Conversion

Refer also to citation(s) 44834, 44864, 45307, 45416, 45429, 46134

44890 (CONF-8905199–1) **Short-rotation wood energy crops: Presentation notes.** Wright, L.L. Oak Ridge National Lab., TN (USA). 1989. 17p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From State of Mississippi energy future symposium; 21-24 May 1989. Order Number DE89016286/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Short-rotation woody crop establishment and management differs considerably from traditional forestry practices. For example, improved hardwoods are used, there is extensive site preparation before planting, and chemical and mechanical weed control is important. Soil nutrient levels are often enhanced with fertilizer or sludge applications. The plantations are established with 2500 to 4000 trees per hectare. The fields actually look like agricultural fields before and just after planting. Irrigation is not recommended in this type of forestry. One of the advantages of this system is that the trees are harvested and allowed to regrow, saving on replanting efforts. Harvesting, however, has always been a big question, particularly because of smaller trees that need specialized harvesters. A few prototype harvesters for small, closely-spaced trees have been built in Canada and Europe, but none are currently being commercially manufactured. Breeding is a very important part of the short-rotation program. Once a desirable tree type is selected, it can be cloned by tissue culture. One of the things that really makes this system work is that clones result in stands with nice uniform trees. This is advantageous from a maintenance and harvesting point of view and also leads to a uniform feedstock for conversion to biofuels, such as methanol or ethanol. 5 figs., 1 tab.

44891 (DOE/ER/13594–T2) **[Photosynthesis in intact plants]: Progress report.** Crofts, A.R. Illinois Univ., Urbana, IL (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER13594. Order Number DE89016272/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The two Joliot-type spectrophotometers (laboratory and field versions) are now operational at the anticipated sensitivity, and we will be using them in the remaining year of the grant. The worth of the portable version has already been demonstrated by our ability to characterize the cycle of ATP synthase activation in intact plants, and we have started an extensive series of field experiments in collaboration with plant physiology and agronomy colleagues on campus. The stopped flow fluorimeter has been used to characterize the kinetics of binding of a range of inhibitors, and we have developed refined atomic models of the quinone and inhibitor binding sites. We have been able to formulate a comprehensive model for turn-over of the two-electron gate, and its inhibition by herbicides. With some support from the present grant, we have developed a computer-aided fluorescence video imaging system, and intend to construct a version of this apparatus for work on intact plants.

44892 (ETDE-mf–9914879) **Community biogas plant Quickborn. Pt. 1 and 2. Pt. 1: Description of the plant and test results. Pt. 2: Development and restoration concept of the pilot project. Final report.** Loll, U.; Reinert, D.; Pawletta, G.; Kohl, J. Loll (U. Dr. Ing.) Abwasser- und Abfalltechnik, Darmstadt (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Feb 1989. 346p. (In German). Contract BMFT PBE-03 C 145. Order Number DE89914879/JAW. Available from NTIS (US Sales Only), PC A15/MF A01.

The biogas plants at Quickborn (Elbe) represent the first community plant in the Federal Republic of Germany. Five single biogas units are connected with a common biogas network, a common gas holder and different gas using installations. The pilot project was stopped after a longer period of successful running on behalf of organizing, technical, juridical and financial problems. (orig.) With 19 refs., 46 tabs., 50 figs.

44893 (GML–75PE1135) **Research and development into new technologies associated with low cost thin film solar cells.** Garrett Mfg. Ltd., Rexdale, ON (Canada). 1975. 35p. (CE–02769). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A proposal is presented for a program of research and development into new technologies associated with low-cost copper sulfide/cadmium sulfide and other copper sulfide heterojunction thin film solar cells. This type of cell is the only one with an observed efficiency approaching the breakthrough figure of 10% considered necessary for economic viability, and as such provides the most promising structure for further research and development at this time. One of the major areas in which improvement can be made is in the method of production of Cu_2S, presently accomplished by the so-called dip process. In this proposal, a program is outlined for developing a new process for this purpose based on the sulfurization of copper. Cells produced with this process have already shown signs of achieving the 10% goal. A small-scale facility would be established for the deposition of good quality CdS in support of cell studies. In addition, investigations of packaging would be undertaken to establish the optimum material for low-cost hermetic cell encapsulation. Other aspects of the proposed program include material investigations of all components at various stages of processing, alternate cell configurations, establishing of a process for vacuum evaporation of CdS on appropriate substrates, and optimization of the vacuum evaporation process. 11 refs., 3 figs.

44894 (ISI-B–16-88) **Investigation of a demand-oriented digester gas production in the framework of the CHP concept in the waste water treatment plant Aistaig of Oberndorf a. Neckar. Final report.** Kunz, P.; Toussaint, D. Fraunhofer-Institut fuer Systemtechnik und Innovationsforschung (ISI), Karlsruhe (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 30 Jun 1988. 194p. (In German). Contract BMFT 02 WS 8583 8. Available from Copy held by UB/TIB Hannover.

The use of multi-unit gas engine driven CHP stations (combined heat and power) in small waste water treatment plants is usually not profitable. The main reasons are oversized CHP units, lack of suitable operating concepts and coordination problems between digester gas production and operation of the CHP plant. The study aims at a demand-oriented digester gas production. This concept has been tested in practice in a waste water treatment plant. The mode of feeding the digester with sewage sludge and/or the addition of external substratum (e.g. high concentration waste water) proved to be suitable for regulating the digester gas production. The relation between the mode of feeding and the resulting gas production has been simulated by a simple computer programme. This simulation can be used as a basic module for developing an automated digestion process. A further programme has been developed to optimize the employment of CHP stations considering to technical and economical aspects. The results of the calculations show that small gas engine driven CHP plants work profitable in waste water treatment if the operation of CHP station and digestion process are coordinated in the above manner (amortization between 5 and 7 years). The study contains a listing of measures facilitating the transfer of the results to other waste water treatment plants. (orig.) With 105 refs., 35 tabs., 80 figs.

44895 (N–89-16917) **NASA photovoltaic research and technology.** Flood, D.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Dec 1988.

12p. (NASA-TM–101422;E–4522;NAS–1.15:101422;CONF-881143–: American Institute of Chemical Engineers annual meeting, 27 Nov - 2 dec 1988). Available from NTIS, PC A03/MF A01.

NASA photovoltaic R and D efforts address future Agency space mission needs through a comprehensive, integrated program. Activities range from fundamental studies of materials and devices to technology demonstrations of prototype hardware. The program aims to develop and apply an improved understanding of photovoltaic energy conversion devices and systems that will increase the performance, reduce the mass, and extend the lifetime of photovoltaic arrays for use in space. To that end, there are efforts aimed at improving cell efficiency, reducing the effects of space particulate radiation damage (primarily electrons and protons), developing ultralightweight cells, and developing advanced ray component technology for high efficiency concentrator arrays and high performance, ultralightweight arrays. Current goals that have been quantified for the program are to develop cell and array technology capable of achieving 300 watts/kg for future missions for which mass is a critical factor, or 300 watts/sq m for future missions for which array size is a major driver (i.e., Space Station). A third important goal is to develop cell and array technology which will survive the GEO space radiation environment for at least 10 years.

44896 (N–89-22177) **A V-grooved GaAs solar cell.** Bailey, S.G.; Fatemi, N.S.; Landis, G.A.; Wilt, D.M.; Thomas, R.D.; Arrison, A. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1988. 9p. (NASA-TM–101970;E–4668;NAS–1.15:101970;CONF-880965–: 20. IEEE photovoltaic specialists conference, 26-30 Sep 1988). Available from NTIS, PC A02/MF A01.

V-grooved GaAs solar cells promise the benefits of improved optical coupling, higher short-circuit current, and increased tolerance to particle radiation compared to planar cells. A GaAs homojunction cell was fabricated by etching a V-groove pattern into an n epilayer (2.1 x 10 to the 17th power per cu cm) grown by metalorganic chemical vapor deposition (MOCVD) on an n+ substrate (2.8 x 10 to the 18th power per cu cm) and then depositing and MOCVD p epilayer (4.2 x 10 to the 18th power per cu cm). Reflectivity measurements on cells with and without an antireflective coating confirm the expected decrease in reluctance of the microgrooved cell compared to the planar structure. The short circuit current of the V-grooved solar cell was 13 percent higher than that of the planar control.

44897 (N–89-22651) **The NASA Space Solar Cell Advanced Research Program.** Flood, D.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 9p. (NASA-TM–102020;E–4747;NAS–1.15:102020;CONF-890211–: 4. international photovoltaic science and engineering conference, 14-17 Feb 1989). Available from NTIS, PC A02/MF A01.

Two major requirements for space solar cells are high efficiency and survivability in the naturally occurring charged particle space radiation environment. Performance limits for silicon space cells are well understood. Advanced cells using GaAs and InP are under development to provide significantly improved capability for the future.

44898 (PNFI–PI-X-59F) **Systems of equations to calculate the anhydrons mass of 18 Canadian species of trees.** Evert, F. Institut Forestier National de Petawawa, Chalk River, ON (Canada). 1987. 65p. (In French). (MICROLOG–87-03780). Available from Petawawa National Forestry Institute, Library, Forestry Canada, Chalk River, ON, CAN K0J 1J0; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report presents a single system of standard equations for estimating ovendry mass for each of 18 Canadian tree species. Each system consists of three equations, one for each of total stem wood, total stem bark, and crowns. When applied to the sample data from individual geographic regions, the overall accuracy achieved by the equations for all species was as follows: for total stem wood, 97% of estimates were within 10% of observed values; for total stem bark, 93% of estimates were within 15% of observed values; and for crowns, 86% of estimates were within 30% of observed values. 13 refs., 4 figs., 51 tabs.

44899 (PNL–6828, pp. 5.5-5.22) **Detection of two engineered pseudomonads and a spontaneous deletion recombinant derivative in soil using gene probes.** Jansson, J.K. (Michigan State Univ., East Lansing (USA)); Holben, W.E.; Tiedje, J.M.; Chelm, B.K. Pacific Northwest Lab., Richland, WA (USA). Feb 1989. In *Evaluation of terrestrial microcosms for detection, fate, and survival analysis of genetically engineered microorganisms and their recombinant genetic material.* Order Number DE89008479/JAW. Available from NTIS, PC A08/MF A01.

In this study we constructed recombinant strains of Pseudomonas sp. as model microorganisms to trace in soil. Pseudomonads are an environmentally and economically important group of organisms. Several are phytopathogens; others seem to promote plant growth. Pseudomonads are also perhaps the most metabolically versatile genus of microorganisms known. Thus, pseudomonads are potentially very important in current and future applied biotechnology and in fact have been proposed for environmental release as hosts for pesticidal and fungicidal agents (22). Pseudomonas cepacia strain PCO1224 and Pseudomonas sp. B8 were used as model organisms in this study. Pseudomonas cepacia strains are being used as benchmark organisms by the US Environmental Protection Agency. Pseudomonas sp. B8 is an aggressive root-colonizing bacterium that inhibits root growth of winter wheat. These strains were engineered to contain a chromosomal insertion of the neomycin phosphotransferase II gene, nptII, which encodes resistance to the antibiotic kanamycin. This gene has previously been shown to be essentially nonexistent in the indigenous bacterial community of the soils used in this study. We have employed DNA probe methodology to specifically detect two different species of Pseudomonas after their addition to soil. In addition, we found evidence of a spontaneous deletion recombination event in the engineered Pseudomonas cepacia strain in soil.

44900 (PNL-SA–15701) **Low-temperature gasification of high-moisture biomass.** Elliott, D.C.; Butner, R.S.; Sealock, L.J. Jr. Pacific Northwest Lab., Richland, WA (USA). Feb 1988. 16p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-880518–6: International conference on research in thermochemical biomass conversion, 2-6 May 1988). Order Number DE89016567/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Pacific Northwest Laboratory is developing a catalytic reactor system for the thermochemical gasification of high-moisture biomass feedstocks. The high-moisture feedstocks which have been tested include many underutilized materials such as energy crops, agricultural residues, aquatic biomass and food processing wastes. The reactor system was operated at low temperature, 350°C to 450°C, and high pressure, 2000-5000 psig. The catalyst was a reduced nickel metal on a silica-alumina support which was sometimes used in combination with sodium carbonate. This paper describes the results of batch reactor tests in which >95% carbon conversion was achieved in producing a product gas consisting essentially of methane and carbon dioxide. 5 refs., 2 figs., 4 tabs.

44901 (PNL-SA–17268) **Research issues: A prospectus for agroforestry.** Hinds, W.T. Pacific Northwest Lab., Richland, WA (USA). Apr 1989. 12p. Sponsored by Environmental Protecction Agency. DOE Contract AC06-76RL01830. DW89933790. (CONF-8904260–1: International conference on planning for agroforestry, 24 Apr 1989). Order Number DE89016389/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Considerable progress is visible in both the concepts and practice of agroforestry projects, over the past few decades. In such circumstances, what might be a useful approach to structure further research or investigations? At least three characteristics come to mind that merit consideration: complexity of the phenomena, criteria for priorities, and choices constrained by resource scarcity. In the next few paragraphs, these three topics will briefly examined. Significant research issues for agroforestry remain urgent, but they tend to be generally site-specific in nature in comparison with other disciplines of field-related research. This site-specific characteristic tends to Balkanize scientific attention, so that choices for research effort reflect local perceptions, and perhaps dilute attention to the overall importance of agroforestry as an investigative disciplines. Furthermore, these issues are notorious for their ecological complexity, so this aspect will be the first to be examined. 23 refs.

44902 (SAND–89-0339C) **United States photovoltaic concentrator technology process and new program initiative.** Chamberlin, J.L.; Boes, E.C. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890925–1: 9. European photovoltaic solar energy conference and exhibition, 25-29 Sep 1989). Order Number DE89013812/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are continuing to see significant progress in the development of photovoltaic (PV) concentrator technology in the USA. This paper briefly summarizes the most significant developments which have occurred in the past 18 months, including descriptions of PV concentrator module development activities, PV concentrator array installations, concentrator cell research progress, results of the latest costing studies, and plans for a Concentrator Initiative Program. 8 refs., 1 fig., 1 tab.

44903 (SAND–89-7035) **Laser grooved and polycrystalline silicon solar cell research.** Green, M.A.; Wenham, S.R.; Chong, C.M.; Narayanan, S.; Fuzu, Zhang; Zolper, J.C.; Sproul, A.B.; Blakers, A.W. Sandia National Labs., Albuquerque, NM (USA); New South Wales Univ., Kensington (Australia). Solar Photovoltaic Lab. Aug 1989. 46p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. Order Number DE89015196/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Research for the period August, 1987–October, 1988 directed at improving the performance of laser grooved, buried contact crystalline silicon solar cells and of polycrystalline silicon cells is described. Key results include the demonstration of 20.6% energy conversion efficiency for 12 cm^2 laser grooved crystalline cells and 19.6% for 47 cm^2 cells of the same type. Several of the larger cells were encapsulated into 28 cm square mini-modules which demonstrated efficiencies up to 17%, significantly higher than previously established figures for silicon modules. Polycrystalline cell efficiency up to 17.8% was demonstrated during the project, again appreciably higher than previous results. 17 refs.

44904 (SERI/CP–211-3550) **Proceedings of the polycrystalline thin film program meeting.** Solar Energy Research Inst., Golden, CO (USA). [1989]. 216p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. (CONF-890851–: Polycrystalline thin film program meeting, 16-18 Aug 1989). Order Number DE89009457/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

Research programs in the following areas are presented: CdTe solar cells; CdTe devices; $CuInSe_2$ fundamentals; and $CuInSe_2$ solar cells. Individual projects are processed separately for the data bases. (CBS)

44905 (SERI/SP–231-3521) **FY 1988 ethanol from biomass annual report.** Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 453p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009460/JAW. Available from NTIS, PC A20/MF A01 - OSTI; GPO Dep.

Ethanol, a high-octane liquid fuel compatible with today's transportation system, can be produced by biological processes from lignocellulose feedstocks. The Alcohol Fuels Research Program, managed by the Solar Energy Research Institute for the US Department of Energy's Biofuels and Municipal Waste Technology Division, conducts a program of research and development to develop processes for converting lignocellulosic materials to ethanol in an efficient and cost-effective manner, and to facilitate the adoption of these processes by industry. This annual report summarizes the state of the art and the research conducted in FY 1988 in acid hydrolysis research, enzymatic hydrolysis research, xylose fermentation, and lignin conversion.

44906 (SERI/STR–211-3529) **Novel thin-film $CuInSe_2$ fabrication: Final subcontract report, January 1989.** Mooney, G.D.; Hermann, A.M. Solar Energy Research Inst., Golden, CO (USA); Arkansas Univ., Fayetteville, AR (USA). J. William Fulbright Coll. of Arts and Sciences. Jun 1989. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009440/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This work studies the feasibility of fabricating $CuInSe_2$ (CIS) solar cells by laser annealing sandwiched layers of elemental Cu, In, and Se. The chalcopyrite phase of CIS now is obtained by thermal annealing elemental Cu and In layers in H_2Se. This process is hazardous because the H_2Se gas is highly toxic. The ability to form the desired chalcopyrite structure by laser annealing would be safer and more conductive to large-scale production. Initial studies of the feasibility of laser annealing the elemental layered structures were performed using a CW argon laser on films fabricated by means of electrodeposition. Characterization of the post-annealed films by x-ray diffraction analysis has shown encouraging results. The laser annealed films have all contained the chalcopyrite phase of CIS. The percentage of the chalcopyrite phase has been small however. Undesirable binary oxides have also formed. To produce higher quality films, future work will concentrate on increasing the percentage of the desirable phase and eliminating all binary compounds. 5 refs., 4 figs., 1 tab.

44907 (SERI/STR–211-3539) **Alternative fabrication techniques for high-efficiency $CuInSe_2$ and $CuInSe_2$-alloy films and cells: Annual subcontract report, 10 November 1987–31 December 1988.** Rockett, A.; Lommasson, T.C.; Talieh, H. Solar Energy Research Inst., Golden, CO (USA). Jul 1989. 45p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009451/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report, the first annual technical progress report for this project, covers the period from November 30, 1987 through December 31, 1988. Results of recent experiments characterizing $CuInSe_2$ deposited by reactive magnetron sputtering and by a hybrid sputtering and evaporation technique are presented. Both techniques produce films with chemical and structural properties comparable with those commonly accepted for polycrystalline $CuInSe_2$ used in solar cells. Transmission electron microscopic analysis of the films produced by the reactive sputtering and hybrid techniques were found to be generally similar to those fabricated by three-source evaporation in terms of microstructure, composition, lattice-defect structure, and compositional uniformity. 28 refs., 19 figs., 1 tab.

44908 (SERI/STR–211-3540) **$CuInSe_2$ solar cell research by sputter deposition: Final subcontract report, January 1985–November 10, 1987.** Thornton, J.A.; Rockett, A.; Lommasson, T.C.; Talieh, H. Illinois Univ., Urbana, IL (USA). Jul 1989. 66p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009450/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This is the final report for a program that began January 1,1986 and ended November 10, 1987. The program focused on developing reactive sputtering as a technique for deposition of $CuInSe_2$ and high-efficiency $CuInSe_2$/CdS heterojunction solar cells. Most of the $CuInSe_2$/CdS devices fabricated thus far from $CuInSe_2$ deposited by reactive sputtering are characterized by relatively low efficiencies caused primarily by low open-circuit voltages, V_{oc}. A contributor to the low V_{oc} appears to be the lower In atom fraction relative to device layers prepared by evaporation, in the top layer of composite two-layer $CuInSe_2$ films (Cu-rich base layer, In-rich top layer) used in our cell fabrication attempts. The lower In fraction is caused by an In-rejection phenomenon that occurs at elevated growth temperatures. This program has focused significant effort on understanding and correcting the phenomenon. Variations in the relative currents to the Cu and In sputtering sources, the H_2Se injection rate, and the substrate temperature have been explored. Slight reductions in the substrate temperature have been found to be effective for increasing the In fraction in the films. 34 refs., 24 figs., 11 tabs.

44909 (STEV-EO–89-13) **Compilation of harvesting results from Swedish energy forestry plantations.** Ohlsson, T. Statens Energiverk, Stockholm (Sweden). 25 Mar 1989. 117p. (In Swedish). Order Number DE89914791/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

This report contains 1345 different biomass production results from trials and plantations of Salix harvested in Sweden during the period from 1980 to 1987/88. Hardly 100 of the 1345 obtained results are from larger practical plantations. Most of these results are,

however, from plantations only 2 years old. There are only 42 results from cultivations older than five years and only 24 results from cultivations with a shoot age more than 4 years. Nine percent (126) of all results show a production of stem biomass above 1.2 kg DM/m^2 and year. Two percent (33) of the results have given a yield above 1.5 kg DM/m^2 and year. The highest production result is 2.3 kg DM/m^2 and year. If the results are limited to trials and plantations where irrigation has not been used during production years, then the average decreases to 1.1 kg DM/m^2 and year and only 39 results fulfill these demands.

44910 (STEV-EO–89-14) **Large scale test South - Energy forestry plantation in southern Scania. Progress report stage 6.** Perman, G. Statens Energiverk, Stockholm (Sweden). Mar 1989. 16p. (In Swedish). Order Number DE89914792/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Production measurements have been done on the field Boerringe 5. The production during the fifth year varies between 7 ton DM/hectare, year and 15 ton DM/hectare, year on different parts on the field. No harvest has been made this winter because there has been no harvest machine available. The production figures are therefore quite unsafe. We have noticed that on different parts of the field some plants are dead. About 30% of the plants are dead (5 year old plantation). We investigate the reason for this. One reason can be the dense plantation (30 000 plants per hectare).

44911 (STEV-EO–89-15) **Energy forestry stage 1 1985-1989.** Eden, P.; Johansson, H. Statens Energiverk, Stockholm (Sweden). 1989. 80p. (In Swedish). Order Number DE89914793/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The experiment covers more than 200 ha and more than 50 growers. The aim of the project is to clarify the biological, technical, economic and organizational conditions for growing Salix on agricultural land in central Sweden. The project covers all aspects of production from establishment and management to harvesting and final utilization. A total calculation will give a cost of more than SEK 120/MWh for Salix chips. Stage 1 has demonstrated that it is possible to establish Salix plantations in central Sweden.

44912 (STEV-VK–89-2) **Energy forestry fuel for the combined power and heating plant in Lund.** Perman, G. Statens Energiverk, Stockholm (Sweden). May 1989. 58p. (In Swedish). Order Number DE89914794/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The investigation shows that energy forest cannot compete with other fuels such as coal, natural gas, peat and fuel chips. The compensation for farming ground is judged to be SEK 1400 +-500 per ha and year. The harvester prototype, the ESM machine has a production capacity of 12 ton dry substance per ha and year. When starting subsidies are included, the price of energy forest chips at the boiler plant will be SEK 0.13 to 0.14 per kWh. The future heat demand of the city of Lund will require a heat production of 100 MW towards the end of the century. If 100% of the fuel is to come from energy forestry, some 16 000 ha of cultivation area will be needed. (G.B.).

44913 (SV-UM–1988-40) **Biofuels.** Ericson, S.O. Swedish State Power Board, Vaellingby (Sweden). 10 Nov 1988. 27p. (In Swedish). Order Number DE89914799/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Forest growth in Sweden is showing an increasing trend and currently represents a fuel value of approximately 250 TWh/year Of this, wood with an energy content of about 160 TWh is used annually, 140 TWh of which in the form of pulp wood and saw timber, as well as approximately 20 TWh as wood or wood chips for energy purposes. The remainder consists partly of small trees as well as twigs and tree tops which are left to decompose in the forests, and partly of an annual increase in the volume of wood in the forests, at present amounting to 25-30 million m^3sk per year with a fuel value of 50-60 TWh. Part of the energy content in pulp wood and timber is contained in lyes, bark and sawdust. These by-products are used as fuel, and at present give a total of about 40 TWh. Together with wood and wood chips extracted for energy purposes this gives a total of 60 TWh/year biofuels. However, in the short term, economic and organizational factors restrict the practical possibility of increasing the use of logging residue (tops and twigs) to perhaps 20-30 TWh. Altogether, the energy content in agricultural crops is equivalent to about at least 50 TWh/yr. Of this, it is primarily straw that could be used for energy purposes and is perhaps capable of giving as much as 10 TWh/yr of fuel. Further large quantities of biofuel can be produced as coniferous, mixed or deciduous forests, or in the form of energy forests or energy crops on agricultural land. In terms of energy, this corresponds to perhaps 15-50 TWh/yr. Utilization of the quantities available on a more extensive scale presupposes that the price is in the region of at least SEK 0.12/kWh free combustion plant. This latter price is approximately 50% higher than the present price of coal, including fuel tax.

44914 (TU/CEA–G-288) **Further development of processes for the conversion of wood to liquid fuels through the operation of a continuous/semi-continuous liquefaction unit.** Boocock, D.G.B.; Mackay, D. Toronto Univ., ON (Canada). Dept. of Chemical Engineering and Applied Chemistry. 1988. 26p. (CE–02759). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

Tests are described using a laboratory-scale continuous/semi-continuous wood liquefaction unit, consisting of a 2-l stirred tank (high pressure) reactor. An aqueous slurry of powdered wood and nickel carbonate catalyst is fed via a tubular lock system. High pressure water displaces the slurry into the reactor. Product discharge is via a dip tube to a cooled lock system from where it is discharged to a separation vessel. The reactor inlet was modified to alleviate plugging problems, and the dip tube for product collection was extended. Heated and cooled sections on the feed line have been used to minimise leaks (due to thermal shock) and valve seat failure. The modified system does not plug when 10 % slurries of less than 60 mesh wood are used. It has been identified that the actual operation of the unit requires several personnel for safe and smooth operation. Carbon balances on the unit have been achieved and 2 runs have been carried out. Results indicate that the wood is undergoing aqueous pyrolytic liquefaction rather than catalytic liquefaction. The feed is brought to the reaction temperature so rapidly that there is insufficient time for the intervention of nickel metal. In addition, it is believed that the nickel carbonate is pyrolyzed to nickel oxide which is then resistant to further reduction. Finally, it is emphasized that a large quantity of CO_2 is produced from the wood, 39% of the wood carbon appearing in this form. Consideration of the gaseous products shows that 46% of the wood carbon is contained in it. 4 refs., 3 figs., 3 tabs.

44915 (TWE–C-172) **Development of analytical methodology for biomass gasification products.** McDonald, E.C.; Aiken, M.; Esplin, G. Techwest Enterprises Ltd., Vancouver, BC (Canada). 1988. 29p. (CE–02755). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

To calculate the conversion efficiency of biomass gasification processes, it is necessary to measure the flow rate, composition and energy content of the various streams entering and leaving the gasifier system. Concurrent calculation of mass balances and energy balances allows an evaluation to be made of the accuracy of these measurements. Conventional stack sampling trains are unsuitable for sampling the high temperature gases and/or high tar concentrations associated with biomass gasification. Consequently, a gasifier sampler was designed and sampling and analytical procedures were developed. The sampler and procedures are described in a related document "A Workbook for Biomass Gasification Sampling and Analysis". This workbook methodology has been proven applicable to both fluidized bed and downdraft gasifiers. Accurate mass and energy balances were achieved for these biomass gasification processes. 7 refs., 3 figs., 10 tabs.

44916 (UBA-FB–89-037) **Representativeness of the natural growth of lichens on trees and the death rate for exposed lichens with regard to the action of pollution and to forest damage from pollution.** Rabe, R.; Wiegel, H.; Brinkmann, B.; Roeckner, G.; Schmiegelt, T.; Steinecke, H.; Waterkotte, A. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.).

Jan 1989. 540p. (In German). Contract UFOPLAN-Nr. 10607060. Available from Copy held by UB/TIB Hannover.

Various bioindication procedures with lichen were investigated with regard to their suitability for the bioindication of air pollution and pollution-related forest damage. For this purpose indices based on the degree of epiphytic lichen vegetation and the death rate for exposed lichen were compared in a multiple regression analysis with pollution and climatic data. SO_2 proved to be the most effective factor influencing the lichen parameters examined. It was found that there were less straightforward but statistically reinforced relations between the lichen parameters on the one hand and air-borne particles and NO_2 on the other. The pollution parameters O_3, CO, NO, and CnHm, as well as the climatic parameters had no influence. Further investigations were conducted in various forest areas. The result was that lichen only seemed suitable as an indicator of forest damage where gaseous air pollutants, in particular SO_2, are attributed a major role in causing the damage. The most suitable bioindication method for establishing the impact of pollution was found to be the IAP method, in spite of a number of methodological deficiencies. Proposals were put forward for further methodological improvements. (orig.) With 100 refs., 124 tabs., 81 figs.

44917 (WOU/ES–C-147) **Ultrapyrolysis of cellulose and wood components.** Western Ontario Univ., London, ON (Canada). Faculty of Engineering and Science. 1983. 178p. (CE–02760). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A fast pyrolysis process, termed ULTRAPYROLYSIS, has been developed in order to exploit the high heating rates, short residence times, high temperatures and rapid quenching, which are required to produce valuable non-equilibrium chemical intermediates from biomass. The equipment whose design is presented in detail, has evolved considerably from the first concept to the final design with the aid of extensive cold model testing. Hot solids are used to carry and transfer heat to biomass particles in a very turbulent vortical contactor. This turbulence creates an ideal environment for fast thorough mixing and extremely rapid heat transfer. Cold solids are used to quickly quench the products. Trials with cellulose, lignin and wood flour were conducted at temperatures between 750 and 900^{0}C and residence times between 250 and 450 milliseconds. Maximum ethylene yields, expressed as a mass fraction of the product gas, were 8.2, 7.3 and 6.3 % for cellulose, wood and lignin trials, respectively at 900^{0}C. Total hydrocarbon yields, also expressed as a mass fraction of the product gas, were 18.8, 19.4 and 23.9 % for cellulose, lignin and wood, respectively, at 900^{0}C. 25 refs., 45 figs., 24 tabs.

1406 Photovoltaic Power Systems

44918 (ILR-Mitt.–184(pt.1+2)/1987) **Definition and economic evaluation of space solar power systems (SSPS). Pt. 1 and 2.** Koelle, H.H.; Sputek, K.; Schulze, M. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt. 15 Aug 1987. 116p. Available from Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt.

This paper describes a life cycle model of a typical space power system as it may come into being in the first half of the next century. The primary inputs for this logistics model are 1. Life cycle duration (100 years); 2. Power level of the SPS at the end of life cycle assumed (500 GW); 3. Power level for single SPS unit (5 GW); 4. Availability of space power units (90%); 5. Specific mass (Mg/MW) of SPS as a function of time. If such a space power system is to be built and operated in geostationary orbit or anywhere else, a logistics system has to transport construction materials, space parts, consumables and also people from various points of origin to the construction site and to the positions the units of SSPS are located. This model allows earth and lunar resources as well as recycling in geostationary orbit. The space transportation system consists of a space freighter and a lunar bus, transporting suppplies and people between the transportation nodes. The launch rates of these space vehicles are determined by this model if the payloads are known. Also the cost per launch of these vehicles must be known if the logistics systems is to be optimized under certain boundary conditions. (orig.).

1407 Solar Thermal Power Systems

Refer also to citation(s) 44944

44919 (ETDE-mf–9914942) **Tests and system analyses within the frame of the test and operating phase of the SSPS-plants in Almeria. Final report.** Jacobs, H. Internationale Atomreaktorbau G.m.b.H. (INTERATOM), Bergisch Gladbach (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Jun 1986. 47p. (In German). Contract BMFT 03E-8211-A. Order Number DE89914942/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Objectives of the SSPS project are the comparison of operation and performance of the CRS and DCS plants and evaluation of the operational plant behaviour in order to allow extrapolation for advanced commercial systems. During the first period of the test and evaluation phase (October 1981 to December 1983) it was requested to maximize the yearly electrical output and to minimize the plant interruptions due to routine maintenance. Testing of components and subsystems had to be performed in parallel with the routine operation and with as little influence on operation as possible. Since a careful and extensive investigation of the plant behaviour needs the performance of additional tests, it was agreed by the nine SSPS member countries to allow particular plant testing in 1984, even if no electricity would be produced. In 1985 a new set of tests was defined and carried out with the aim to increase the load of the CRS external sodium receiver up to its stress limits. This report contents the main results of the items investigated and of the operational experience of both plants. (orig.) With 35 refs., 17 figs.

44920 (SAND–88-2862C) **Thermal nuclear blast simulation at the National Solar Thermal Test Facility.** Cameron, C.P.; Ghanbari, C.M. Sandia National Labs., Albuquerque, NM (USA). [1989]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909179–1: 11. international symposium on military applications of blast simulation, 10-13 Sep 1989). Order Number DE89016032/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The National Solar Thermal Test Facility is operated by Sandia National Laboratories and located on Kirtland Air Force Base in Albuquerque, New Mexico. The facility includes a heliostat field and associated receiver tower, two solar furnaces, and two point-focus parabolic concentrators. All can be used for simulating the thermal portion of nuclear pulses. The heliostat field contains 222 computer-controlled mirrors, which reflect concentrated solar energy to test stations on a 61-m tower. The field produces a peak flux density of 250 W/cm^2 over a 15-cm diameter with a total beam power of over 5 MW$_t$. Thermal nuclear blasts have been simulated using a high-speed shutter (opening and closing time of 0.15 sec over a 1-m wide aperture) in combination with heliostat control to produce square or shaped pulses. The shutter can accommodate samples up to 1 x 1 m and it has been used by several US and Canadian agencies. A glass-windowed wind tunnel located behind the shutter can accommodate samples up to 48 x 76 cm with simultaneous exposure to the thermal flux and air flow at velocities up to 120 m/s. Each solar furnace at the facility includes a heliostat, a non-tracking parabolic concentrator, and an attenuator. One solar furnace produces flux levels of 270 W/cm^2 over a 6-mm diameter and total power of 16 kW$_t$. A second furnace, currently under construction, will produce flux levels up to 1000 W/cm^2 over a 4-cm diameter and total power of 65 kW$_t$. Both furnaces include shutters and attenuators that can provide square or shaped pulses. The two 11-m diameter tracking parabolic point-focusing concentrators at the facility can each produce peak flux levels of 1500 W/cm^2 over a 2.5-cm diameter and total power of 75 kW$_t$. High-speed shutters have been used to produce square pulses. 5 figs.

1408 Ocean Energy Systems

44921 (CONF-8909128–1) **Planning for hybrid-cycle OTEC experiments using the HMTSTA test facility at the Natural Energy Laboratory of Hawaii.** Panchal, C.; Rabas, T.; Genens, L. Argonne National Lab., IL (USA). 1989. 5p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. From Oceans '89 conference; 18-21 Sep 1989. Order

Number DE89013278/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy has built an experimental apparatus for studying the open-cycle Ocean Thermal Energy Conversion (OC-OTEC) system. Experiments using warm and cold seawater are currently uderway to validate the performance predictions for an OC-TEC flash evaporator, surface condenser, and direct-contact condenser. The hybrid cycle is another OTEC option that produces both power and desalinated water, it is comparable in capital cost to OC-OTEC, and it eliminates the problems associated with the large steam turbine. Means are presented in this paper for modifying the existing apparatus to conduct similar experiments on hybrid-cycle OTEC heat exchangers. These data are required to validate predictive methods of the components and for the system integration that were identified in an earlier study of hybrid-cycle OTEC power plants. 7 refs., 4 figs., 2 tabs.

44922 First production of potable water by OTEC and its potential applications. Thomas, A. (Argonne National Lab., IL (USA)); Hillis, D. pp. 1727 of Oceans '88. IEEE Service Center, Piscataway, NJ (1988). (CONF-8810180--: OCEANS '88, 31 Oct - 2 nov 1988).

The DOE-funded project is a joint effort between Argonne National Lab. (ANL) and the Solar Energy Research Institute (SERI). The apparatus was erected at the Natural Energy Lab. of Hawaii and became operational in the summer of 1987. It is used by both ANL and SERI to conduct open-cycle OTEC experiments. After initial debugging, it produced 350 gallons per hour of potable water having a salinity of 86 ppm, one-fifth that of local tap water available at the test site.

1409 Solar Thermal Utilization

Refer also to citation(s) 45186, 45199, 45338, 45339, 45341, 45343, 45359, 45360

44923 (CONF-8806404--, pp. 1-4) **Chances of solar energy in Northern Germany.** Schreitmueller, K.R. (Institut fuer Solarenergieforschung GmbH (ISFH), Hannover (Germany, F.R.)). Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. (In German). From Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988. In *Efficient use of solar energy in solar heated swimming pools.* Order Number DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Possibilities to use solar energy in Germany, especially in the North, are looked into. Swimming pool water heating is one of the best areas for efficient use of solar energy. The principle of solar thermal utilization is explained by taking a solar collector as an example. As swimming pool collectors work at only a few degree more than the ambient temperature there is no need for insulation against radiation-, line- or convection losses. Non-covered, low-priced plastic collectors can be used. For service water heating in our climatic zone however, one needs at least transparent covers in order to reduce radiation and convection losses. Even with swimming-pool heating, easy as it may seem, it is necessary to follow certain principles lest the installation becomes a lottery game. (BR).

44924 (CONF-8806404--, pp. 5-12) **Solar heated swimming pools - experiences from the demonstration project 'Energy conservation measures in swimming-pool construction' supported by the Federal Ministry of Research and Technology and the EC.** Luboschik, U. (IST Energietechnik G.m.b.H., Kandern (Germany, F.R.)). Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. (In German). From Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988. In *Efficient use of solar energy in solar heated swimming pools.* Order Number DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

About 50 swimming pools were built in the EC between 1979 and 1983, six of them in the Federal Republic of Germany. These six were financially subsidized as demonstration projects for solar pool heating. The project also included further measures such as pool covering, heat recovery etc. The main results gained from this project are described in this article. The specific differences between the six solar heated pools in Unna, Schwahntal, Ahaus, Inzell and Uelzen are described. One found out that unglazed solar systems are extremely suitable for outdoor pool heating as their cost-benefit ratio is better than that of glazed ones. Solar pool heating is especially economical if one can do without additional heating. Using both heat pumps and unglazed solar systems did not prove to work neither technically nor economically. Additional fossil-fueled heating should be done without. (BR).

44925 (CONF-8806404--, pp. 13-21) **Thermografic studies of large absorber fields to record flow disturbances.** Croy, R. Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. (In German). From Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988. In *Efficient use of solar energy in solar heated swimming pools.* Order Number DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

In order to guarantee a uniform flow within absorber fields, the pressure drop in the absorbers should be large enough to play the determining part in the overall pressure drop of the hydraulic system. Only then can one neglect the ever present small network failures one should also see to it that the difference between the flow velocities in distributing lines and absorber channels are kept as low as possible (edge swirls, suction effect etc.). This, however, requires a precise calculation of the whole hydraulic system which takes the minimum flow velocities in the absorber channels into account. (orig./BWI).

44926 (CONF-8806404--, pp. 22-29) **The use of pool covers within the demonstration project.** Fey, H. Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. (In German). From Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988. In *Efficient use of solar energy in solar heated swimming pools.* Order Number DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Appropriate use of pool covers can reduce evaporation-, convection-, and radiation losses. The demonstration project 'pool covers' which is part of a larger project on solar pool heating and is sponsored by the EC and the Federal Ministry of Research and Technology compares the different systems and brands used in 5 of the 6 pools in Germany. The shape of a pool greatly influences the cost and technical feasibility of a cover. Before planning a pool cover one should therefore calculate the economic efficiency. Heat consumption without cover and expected savings from the cover need to be known. Investment costs for all necessary cover parts vary greatly but can be assumed to be between 100,- and 350,- DM/m^2 of cover. (BR).

44927 (CONF-8806404--, pp. 39-45) **An operator's experience with a solar heated swimming pool.** Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. (In German). From Seminar on efficient use of solar energy in solar heated

swimming pools; 9 Jun 1988. In *Efficient use of solar energy in solar heated swimming pools.* Order Number DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This report deals with energy saving systems installed in a swimming pool at Uetzen within the demonstration project of the EC and the Federal Ministry of Research and Technology. These are systems for active and passive energy saving. One of the active ones is the solar absorber installed on the roof of an annex building of the pool which works together with a heat pump (direct pool) as well as heat recovery from filter rinsing water and off air. Pool covers work on the principle of passive saving. Cost, information on manufacturers, energy saving, data operational experience etc. of the various measures are described. The report recommends thorough studies of energy saving possibilities and manufacturers data on the same before entering upon such a project. (BR).

44928 (CONF-8806404–, pp. 46-52) **Where to apply for information on the research project 'Energy conservation in swimming pools'.** Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. (In German). From Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988. In *Efficient use of solar energy in solar heated swimming pools.* Order Number DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Short description of places where to obtain information on the research projects 'Energy conservation in swimming pools'. BINE (Citizen's Information Bureau on New Energy Technologies), BISp (Federal Institute for Sport Science); ISFH (Institute for Solar Energy Research), PBE (Project Management Biology, Ecology, Energy); ZFS (Central-Bureau for Solar Technology). (BWI).

44929 (DOE/CE/30806–T2) **Passive and hybrid solar low energy building: Subtask A, Performance evaluation procedures, Task 8.** Moerck, O. (ed.); Holtz, M.; Swisher, J.; Blomsterberg, A.; Jacobsen, T. International Energy Agency, 75 - Paris (France). Programme to Develop and Test Solar Heating and Cooling Systems. Oct 1988. 126p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-84CE30806. Order Number DE89016112/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; GPO Dep.

This document presents the common monitoring and performance evaluation procedures used by the participants of IEA Task VIII – Passive and Hybrid Solar Low Energy Building – to evaluate the performance of the passive and hybrid solar homes constructed as part of this international cooperative research effort. Although the performance evaluation procedures were developed specifically for Task VIII, they are useful for any monitoring activity involving passive and hybrid solar homes. The document is organized into seven chapters. Each chapter addresses a different requirement of a successful performance evaluation program. The early chapters (1 and 2) discuss the elements of a monitoring project and the necessity for clearly defining the monitoring objectives. Chapter 3 presents the performance evaluation methodology for passive and hybrid solar homes, including a list of common performance factors. Chapters 4 and 5 discuss the preparation of the monitoring plan and establishing the data and instrumentation requirements. Chapter 6 discusses data reduction procedures, while Chapter 7 presents a recommendation for documenting the building, passive and hybrid system, the data acquisition system and the results. 36 refs.

44930 (DTH-LV-MEDD–205) **High-yield solar heating system with low volume flow. Experimental investigations.** Furbo, S. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Mar 1989. 115p. (In Danish). Order Number DE89914669/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Three small solar heating systems for domestic hot water supply have been tested under the same conditions: A reference system with a normal volume flow rate and a hot water tank with a built-in heat exchanger spiral and two identical systems with a low volume flow rate and a hot water tank with a mantle welded around a part of the surface of the tank. The reference system is identical with most of the systems marketed in Denmark today. Different operation strategies are tested for the systems with the mantle storage. The experiments were carried out with two different solar collector types. Five identical solar collectors with different volume flow rates have been tested under the same conditions with the same inlet temperature. The daily thermal performance of each solar collector has been measured. The experiments showed that the solar heating system with a mantle storage and a low volume flow rate is extremely attractive. This system performs about 20% better than the reference system in periods with a solar fraction of about 55% for the reference system. The solar collector tests showed that the efficiency of the solar collectors under typical operation conditions is not much influenced by variations in the volume flow rate. The increase in the thermal performance of the low flow mantle storage system is first and foremost caused by the temperature stratification, which is built up in the heat storage during periods with the solar collector in operation. (author) 23 refs.

44931 (NEI-DK–180) **Danish solar hot water systems.** Esbensen og Korsgaard Raadgivende Civilingenioerer, Copenhagen (Denmark). [1989]. 15p. Order Number DE89914636/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Also published in Danish as Solvarme til procesindustri og varmtvandsproduktion; EFP-86.

Recommendations for Danish consulents and entrepreneurs who hold projects abroad involving the use of hot process-water or where it is otherwise necessary to produce hot water. A few examples of Danish export potential in developing countries are presented. (AB).

44932 (OUP–88-24) **Solar energy at the Department of Physis, Oslo University.** Oslo Univ. (Norway). Fysisk Inst. 1988. 12p. (In Norwegian). Order Number DE89914787/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report gives a survey and an evaluation of the various solar energy projects at the Oslo University. The projects concern solar energy systems designed for water heating, space heating, and grass drying. The grass dryers are operating at farms located in mountaineous areas. The technical and economic data for the various systems are presented. 1 tab., 20 refs.

44933 Long-term test and technical-scientific advise as assistance to the development and introducing of solar water heaters. Final report. (Langzeittest und technisch-wissenschaftliche Beratung als Hilfestellung zur Entwicklung und Markteinfuehrung von solaren Warmwasserbereitern. Schlussbericht). Scharl, G. 70p. Bundesministerium fuer Forschung und Technologie, Bonn (Oct 1986). (In German). Contract BMFT 03 E 8151 A.

Within the scientific cooperation with the National Research Center various types of thermosyphon plants were tested in Cairo. Solar plants of 4 German and German-Egyptian manufacturers were selected, installed in a village in the Nil delta and controlled over a period of several years. Some plants were installed at the NRC-SEL in order to provide the basis for further joint examinations. Statistical investigations were conducted with regard to the long-term behaviour of the plants installed in the rural area. The results were delivered to the manufacturers and had influence on the designs of the two German-Egyptian joint ventures, partly to a considerable extent. In parallel to these long-term tests new developments from West Germany were tested in cooperation with the NRC-SEL. The test results from the NRC served to further improve the plants installed in Mit Abu El Kom. (orig./BWI) With 10 tabs., 39 figs.

1410 Solar Collectors and Concentrators

Refer also to citation(s) 44902, 45383

44934 (NEI-DK–185) **Danish export of solar heating technology. Danish produced self-circulating solar heating units, testing - recommendations.** Ellehauge, K.; Esbensen, T. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering; Esbensen og Korsgaard Raadgivende Civilingenioerer, Copenhagen (Denmark). Oct 1987. 40p. (In Danish). Order Number DE89914642/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

EFP-86.

Using three Danish-manufactured solar water-heating systems, tests were made regarding their suitability for use in climates where high temperatures predominate. The risk of boiling and standards of durability were examined and suggestions for improvement are offered. (AB).

44935 (NEI-DK–187) **Danish export of solar-heating technology. Demands for functional efficiency in the case of solar collectors used in the developing countries.** Esbensen og Korsgaard Raadgivende Civilingenioerer, Copenhagen (Denmark). Feb 1987. 31p. (In Danish). Order Number DE89914644/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

EFP-86.

Recommendations regarding the design and construction of Danish-manufactured solar collectors where climatic conditions of developing countries impose quality demands on this type of Danish export potential. (AB).

44936 (NEI-DK–200) **Avoidance of failures in solar collector system. IEA Task 3: performance testing of solar collectors, Subtask F: service life testing of solar collector components and materials.** Vejsig Pedersen, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. May 1986. 75p. Order Number DE89914673/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

EFP-83.

This report presents a compilation of 4 papers on avoidance of failures in solar collector systems. The papers are contributed by participants of the IEA Solar Heating and Colling Programme, Task III, from Sweden, Switzerland, Austria, Germany and Denmark. The papers deal with degradation factors in flat plate solar collectors, corrosion aspects in piping systems, building integrated solar collector systems and results from test of 14 solar heating systems for domestic hot water. (author).

44937 (NEI-DK–200, pp. 5-33) **Factors relating to the degradation of materials in flat plate solar collectors.** Wennerholm, H. (National Testing Laboratory, Boraas (SE)). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. May 1986. In *Avoidance of failures in solar collector systems. IEA Task 3: performance testing of solar collectors, Subtask F: service life testing of solar collector components and materials.* Order Number DE89914673/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The widespread use of flat plate solar collectors is being held back by lack of confidence in the long term durability of the component materials. Every material has a particular set or range of conditions under which it exhibits greatest ability to maintain its most desirable properties. This paper presents a review of the suitability of specific materials for components in flat plate solar collectors during exposure to weather conditions. Ambient factors that influence the atmospheric degradiation of materials are weather conditions, biological factors, mechanical factors, combinations of incompatible materials and application conditions. Weather conditions are, solar radiation, temperature, precipitation, humidity, wind, normal air components, and pollution. The most important factor promoting atmospheric corrosion of metals is the percentage of time when the critical humidity is exceeded. This period is called the time-of-wetness. Corrosion rates of most metals normally accelerate when metals are exposed to polluted environments. The agents constituting pollution that have been identified with corrosion can be listed as sulphur dioxide, hydrogen sulphide, ammonia, nitrogen oxides, sodium chloride, and particulate matter. The ultraviolet component in solar radiation plays an important role in the decomposition of organic materials. Other factors are heat, high humidities, oxygen, ozone, micro-biologic organisms, air pollution substances, wind, and dust. Synergistic associations are capable of effecting chemical transformations which are beyond the separate abilites of each degradation factor. And that affect both inorganic and organic materials. (author) 67 refs.

44938 (NEI-DK–200, pp. 34-47) **Corrosion aspects in solar energy systems for domestic hot water preparation and room heating.** Keller, J. (Swiss Federal Institute for Reactor Research (EIR), Wuerenlingen (CH)); Bruck, M. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. May 1986. In *Avoidance of failures in solar collector systems. IEA Task 3: performance testing of solar collectors, Subtask F: service life testing of solar collector components and materials.* Order Number DE89914673/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

An abridged overview of the basic corrosion effects is given. A corrosion surveillance program of the domestic hot water system of the EIR restaurant OASE at Wuernelingen was carried out. The heat transfer fluid of the flat plate collector loop is checked. The basic conclusions are that corrosion in the loop as well as the metal content in the fluid cannot be recorded by pH or electrical conductivity readings. Moreover, chemical analysis of fluid samples gives no information about the amount and the progression of corrosion. On the other hand circuit material samples mounted in a circuit bypass are periodically checked and the metal loss is weighted. Corrosion on red brass, mild steel and stainless steel is negligible, whereas aluminium suffers a considerable corrosion attack. The greatest quantity of metal loss was detected after the first year. During the subsequent years the corrosion rate decreased because of a build up of corrosion-retarding surface layers. In a second set of experiments performed at the School of Engineering at Rapperswil (CH) eight different metal samples were conductively joined on a common mounting support. Fourteen of these supports were immersed in different heat transfer fluids exposed to a cyclic temperature variation between 20 deg C and 90 deg C. The mass losses were determined periodically. It could be shown that there are very significant differences between different materials as well as different fluids amounting to about one or two orders of magnitude. A summary of the recommendations "Regeln zum Korrosionsschutz von Solaranlagen zur Wassererwaermung" issued by the working group "Corrosion of solar energy systems" initiated by the "Detusche Gesellschaft fuer chemisches Apparatewesen e.V. (DECHEMA)" is presented. (AB).

44939 (NEI-DK–201) **Proceedings from workshop on service life of solar collector components and materials. IEA Task 3: performance testing of solar collectors, Subtask F: service life testing of solar collector components and materials.** Vejsig Pedersen, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Aug 1984. 157p. (CONF-8312130–: 3. IEA task workshop on service life of solar collector components and materials, 6-7 Dec 1983). Order Number DE89914677/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-83.

This report presents the proceedings of the workshop on Service Life of Solar Collector Components and Materials held at the Technical University of Denmark in December 1983. 16 Participants from 10 different countries of the IEA Solar Heating and Cooling Programme, Task III were present at the workshop, and 15 papers were presented. The paper presentation and discussion covered: 1. Accelerated material tests and service life testing, 2. Complete collector tests and, 3. Operational experience with solar collector systems. The report includes a short summary of each of the presented papers and discussion and conclusions reached in this connection. A proposal for a common experiment of how to measure the inside solar collector environment evolved from the discussions, is also included. (author).

44940 (NEI-DK–201, pp. 129-135) **EIR solar heating plant corrosion surveillance program.** Wiedemann, K.H. (Swiss Federal Institute for Reactor Research (EIR), Wuerenlingen (CH)). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Aug 1984. (CONF-8312130–: 3. IEA task workshop on service life of solar collector components and materials, 6-7 Dec 1983). In *Proceedings from workshop on service life of solar collector components and materials. IEA Task 3: performance testing of solar collectors, subtask F: service life testing of solar collector components and materials.* Order Number DE89914677/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-83.

For a corrosion surveillance program of the EIR solar heating unit OASE, the coolant of the flat collector circuit has been controlled and material samples mounted in a circuit by-pass have been tested periodically. The results of the first 13 months are published in the EIR-Report No. 457. This report presents the results of the coolant

tests as well as the material sampels tests after 25.5 or 33 months of surveillance, respectively. At the start of the program the composition of the coolant was 65 Vol. % deionized water, 35 Vol. % ethylenglycol, and 15 g/l inhibitor. This composition remained practically constant. The metal contents of the coolant samples show large differences, because of deposits of metal containing precipitates, the amount of them being temporal and locally different; p_H and electrical conductivity remained practically constant. Therefore, corrosion in the circuit cannot be recorded by p_H or electrical conductivity readings or by chemical analysis of coolant samples. The metal losses at the material samples in the by-pass have been determined after two years: aluminium ca. 70 μm; mild steel St 37 ca. 0.3 μm; red brass RG-5 ca. 0.4 μm; stainless steel Cr Ni 18 10 ca. 0.1 μm. The greatest quantity of the metal loss occured during the first year and increased only slightly during the second year. Pitting corrosion has not been obeserved on any material. (author).

44941 (NEI-DK–201, pp. 147-152) **Condensation problems with roof-integrated solar collectors in climates in Northern countries.** Vejsig Pedersen, P. (Thermal Insulation Laboratory, Technical University of Denmark (DK)). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Aug 1984. (CONF-8312130–: 3. IEA task workshop on service life of solar collector components and materials, 6-7 Dec 1983). In *Proceedings from workshop on service life of solar collector components and materials. IEA Task 3: performance testing of solar collectors, subtask F: service life testing of solar collector components and materials.* Order Number DE89914677/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-83.

Condensation on the inside of the glass cover in solar collectors is a wellknown problem in humid northern climates. Radiation of heat from the glass cover to the sky during the night results in a temperature decrease of a few degrees Celsius from the ambient temperature. In humid and cold climtes this will often lead to condensation on the inside of the glass cover. Built-in ventilation of a solar collector can often remove the condensate in a few hours when the absorber temperature is increased due to the solar insolation. Many solar collectors, because of a humid atmosphere in the collector itself, show heavy condensation over long periods, especially in the winter. This could be because rainwater has penetrated the collector, the collector construction is not protected adequately against humid air coming from the interior of the house to which the collectors are mounted, or the collector construction is not sufficiently ventilated. Here it is important to allow a chimney effect in the collector. Heated ventilation air at the top of the collector, to which condensate from the glass cover has been evaporated, must be able to leave the collector without condensing again in unwanted places. Under some circumstances the result has been a complete degradation of the solar absorber surface treatment after only few years of opeation. Methods for avoiding condensation in solar collectors are described. (AB).

44942 (NEI-DK–201, pp. 119-122) **Presentation and evaluation of indoor test procedures for the durability of solar collectors, as presenly used in the Netherlands.** Koelimij, A. (I.B.B.C - TNO (NL)). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Aug 1984. (CONF-8312130–: 3. IEA task workshop on service life of solar collector components and materials, 6-7 Dec 1983). In *Proceedings from workshop on service life of solar collector components and materials. IEA Task 3: performance testing of solar collectors, subtask F: service life testing of solar collector components and materials.* Order Number DE89914677/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-83.

Test program for the determination of the service life of a solar collector based on the measurement of air leakage, efficiency and to what extent the solar collector is raintight, followed by loading tests. Results of tests on 6 flat plate solar collectors are presented and general conclusions offered. (AB).

44943 (NEI-DK–201, pp. 123-128) **Prevention of corrosion-, scale-formation anf fouling-damage in low- and medium temperature closed loop collector systems.** Bruck, M. (Austrian Solar and Space Agency, Vienna (AT)). Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varmeisolering. Aug 1984. (CONF-8312130–: 3. IEA task workshop on service life of solar collector components and materials, 6-7 Dec 1983). In *Proceedings from workshop on service life of solar collector components and materials. IEA Task 3: performance testing of solar collectors, subtask F: service life testing of solar collector components and materials.* Order Number DE89914677/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

EFP-83.

An overview of the state of the art of the ongoing "corrosion activities" of the "solar group" of the Austrian Standards Institution is presented. Characteristics of low and medium temperature closed loop collector systems are mentioned as well as important properties of circulating water: pH, hardness, alcalinity and conductivity. (author).

44944 (SAND–89-0839C) **Stretched-membrane heliostats for solar central-receiver power plants.** Alpert, D.J.; Houser, R.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 12p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890836–8: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, 6-11 Aug 1989). Order Number DE89016034/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

For more than 10 years, the US Department of Energy's Solar Thermal Program has pioneered the developed of heliostats, mirrors that track the sun, for solar central-receiver power plants. The field of heliostats is the single most expensive part of such plants, so their cost must be as low as possible for the technology to be commercially successful. Recent efforts have focused on the development of heliostats that use stretched-membrane reflectors in place of the more familiar glass mirrors. In a stretched-membrane heliostat, metal foils are stretched over both sides of a large-diameter metal ring. The reflective surface is a silvered-polymer film glued to the front membrane. A slight vacuum in the space between the two membranes is actively controlled to provide a concave, focused contour to the mirror, and in an emergency this space can be rapidly pressurized to defocus it. Because of their simplicity and lighter weight, stretched-membrane heliostats have the potential to cost significantly less than current glass-mirror designs. The first 50-m^2 mirror modules, built under contract to Sandia in 1986, demonstrates that the optical performance of membrane heliostats would be at least as good as heliostats using glass mirrors. Insights gained from Sandia's testing and evaluation of the first-generation units were incorporated into the designs of two improved 50-m^2 mirror modules that were recently completed. Preliminary measurements show significant improvement in optical performance over the first-generation designs, especially in windy conditions. 19 refs., 7 figs.

1420 Heat Storage

44945 (EPRI-CU–6482) **Soil and rock classification according to thermal conductivity: Design of ground-coupled heat pump systems: Final report.** Salomone, L.A.; Marlowe, J.I. Electric Power Research Inst., Palo Alto, CA (USA); STS Consultants Ltd., Chantilly, VA (USA). c Aug 1989. 341p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This study establishes the ranges of values of thermal conductivity and thermal diffusivity of the various soils and rocks in the United States and provides this information in a form that can be used in the design of ground-coupled heat pump systems. It presents a simple classification system for use in the identification of soils and rocks by persons not trained in soil mechanics or petrology. This technical document is given practical application in a companion field manual for the identification and classification of thermal conductivity of the various soils and rocks that can be encountered in the United States. The field manual, supported by EPRI, was published by the International Ground Source Heat Pump Association. The soil study provides a correlation between thermal resistivity and moisture content. It examines temporal behavior of ambient soil moisture and influence of environmental factors on soil moisture

content. It cites factors known to influence soil moisture content, and the National Soil Moisture Study, which provided ambient soil moisture data for a four- to six-year period in six states. It discusses limit states of soil moisture content (field capacity and wilting point) and use of these states to define approximate extremes of ambient soil moisture levels. It proposes a new method of normalization of soil moisture content by its limit states – the thermal moisture index – and investigates some of its properties. It uses a mathematical simulator of soil/water hydraulics – the EPIC model – to illustrate effects of soil texture, precipitation, and soil temperature on soil moisture under more controlled conditions and with greater geographic coverage than is obtainable from National Soil Moisture Study data. Results of this study demonstrate that four general soil groups can be used to determine earth-loop size (pipe length) for ground-coupled heat pump systems. 48 refs., 162 figs., 26 tabs.

44946 (ITL–8509, pp. 594-599) **Quality loss from seasonal storage of heat in rock, magnitude and evaluation.** Rosenblad, G. (Chalmers Univ. of Technology, Goeteborg, Sweden). Intertask Ltd., Ottawa, ON (Canada). 1985. (CONF-850905–: ENERSTOCK '85 - 3. international conference on energy storage for building heating and cooling, 22-26 Sep 1985; MICROLOG–89-00267). In *Enerstock 85. 3rd International conference on energy storage for building heating and cooling. Proceedings.* Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Quality losses, characterized by a temperature drop between loaded and unloaded heat, are discussed for three types of seasonal storages in rock; caverns, boulder-filled caverns, and borehole-storages. Energy losses have been calculated from computer results of the exit temperatures for storage cycles for the different storage types. Caverns and boulder-storages have roughly the same energy losses after deducting the energy in heat losses. In borehole-storages the corresponding losses are 3.5 times larger in spite of a lower maximum temperature limit. For borehole-storages the quality losses are percentually the same for different distances between the holes. Unloaded heat will decrease if the hole-distances are increased, but the total length of all the bored holes will decrease still more, which argues for large distances. It is possible to increase the heat quantity from a storage if the lower temperature limit is decreased by a heat pump. That can be of economical interest for caverns and boulder-storages. The energetic efficiency seems to be the best way to describe the total quality of a storage. The heat efficiency figures do not account for inner thermodynamic losses that may be of great importance for the use of the unloaded heat. 4 figs., 4 tabs.

15 GEOTHERMAL ENERGY

Refer also to citation(s) 45201

1502 Geology and Hydrology of Geothermal Systems

44947 (EGG-M–89081) **Properties of geopressured brines and wells in the Gulf Coast and opportunities for industrial/research participation.** Negus-de Wys, J. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 8p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (CONF-890352–10: US Department of Energy research and development for the geothermal marketplace: 7th geothermal program review, 21-23 Mar 1989). Order Number DE89016169/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Geopressured reservoirs exhibit pressure gradients in excess of the normal hydrostatic gradient. (In the Gulf Coast area the normal gradient is 0.465 psi/ft.) Pressures may approach lithostatic pressure and have been measured as high as 1.05 psi/ft in the Gulf Coast area. Geopressured basins exist worldwide and in a number of US locations, east, west, north and south. The Gulf Coast area has been studied extensively and is the subject of the DOE geopressured-geothermal research at present. Present industrial interest in the Pleasant Bayou and Hulin wells include: desalination plants, an economic study by a power company for regional use, use of generated electricity by a coalition of towns, aquaculture (catfish farming) research program, and an unsolicited proposal for enhanced oil recovery of heavy oil. Direct uses of the hot brine cover dozens of industries and processes. An example of multiple uses in the USSR is shown. A research spin-off: a sensitive in-line benzene monitor has been designed by USL and will be tested in the near future. An in-line pH monitor is also under development for the harsh conditions of the geopressured-geothermal wells. 24 refs., 12 figs.

1503 Geothermal Exploration and Exploration Technology

Refer also to citation(s) 44951, 44969

1506 Environmental Aspects and Waste Disposal

44948 (EPRI-GS–6380, pp. 65-72) **Results on upstream removal of impurities from flashed geothermal steam.** Lam, L. (Instituto de Investigaciones Electricas, Altos (Mexico)); Angulo, R.; Gonzalez, J.; Ayala, R.; Meza, F.; Cervantes, M.; Sampedro, J. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A second part of a project to evaluate the reboiling process at the Cerro prieto geothermal field is being performed. The equipment was rebuilt and a stripping column was added in order to improve the gas removal efficiency of the system. The main objective of the project is to evaluate the capability of the system, enhanced with a stripping process, to remove impurities form geothermal steam. Other activities include a comparison between three analytical methods to determine arsenic. The key parameters for the enhanced reboiling process are the vent rate and the stripping steam flow. Preliminary results showed an average 98% gas removal efficiency, even at vent rate as low as 3%. H_2S interference in arsenic determination was found and eliminated using a lead acetate trap. As an additional activity a gas removal computer model is being developed.

44949 (EPRI-GS–6380, pp. 101-110) **H_2S monitor development program.** Thoma, A.L. (Pacific Gas and Electric Company, Healdsburg, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A joint program is being conducted by the Northern Sonoma County Air Pollution District, Pacific Gas and Electric and three other utilities to develop a continuous H_2S monitor for geothermal power plants. The labor-intensive nature of the current method for measuring emissions makes it inadequate for utility and regulatory objectives. Testing focused on analyzers which monitor the concentration of H_2S in the steam condensate or in the circulating water. Of the six analyzers tested, two performed satisfactorily in power plants that do not require secondary H_2S abatement chemicals. Additional research is planned to develop monitors for power plants that do require abatement chemicals.

44950 (EPRI-GS–6380, pp. 173-184) **Geothermal hazardous materials and waste minimization program.** Hanley, C.R. (Pacific Gas and Electric Company, San Francisco, CA (USA)); Dorighi, G.P.; Talley, C.Y. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The geothermal steam at Pacific Gas and Electric Company's Geysers Geothermal Project contains hazardous constituents of which hydrogen sulfide (H2S) presents the greatest problem. The H2S removal processes needed to comply with local air pollution regulations consume a large volume of hazardous materials and generate the major portion of the total waste for the geothermal plant. Although land-based disposal of hazardous wastes was preferred in the 1970's, recent legislation has eliminated this preference and established new and rigorous guidelines regarding hazardous waste management. Pacific Gas and Electric Company has implemented a program to minimize the consumption of hazardous materials and the generation of hazardous wastes. This program allows the Company to comply with pertinent legislation, yet continue to operate The Geyser Power Plant in a cost effective manner.

1508 Geothermal Power Plants

Refer also to citation(s) 44948, 44949

44951 (EPRI-GS–6380, pp. 3-10) **The DOE [U.S. Department of Energy] geothermal R & D program - positioning geothermal technology for a decade of expansion.** Mock, J.E. (Department of Energy, Washington, DC (USA)); Ford, D.G. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Current estimates indicate that the demand for electric energy in the US may grow substantially over the coming decade. It is this period of growth that the US geothermal industry is looking toward as a stimulus to expansion of geothermal energy development. The DOE [US Department of Energy] geothermal R & D program is working to overcome the major technological barriers to increased utilization of our nations's hydrothermal and advanced forms of geothermal energy. The near-term hydrothermal R & D activities are reviewed in the context of the programs's long-term goals and objectives.

44952 (EPRI-GS–6380, pp. 23-27) **EPRI [Electric Power Research Institute] geothermal program.** Roberts, V.W. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The main elements of current R&D strategy within the Geothermal Program are as follows: (1) increase the total amount of hydrothermal resources that can be economically developed, (2) develop advanced cost effective technologies for upstream noncondensable gas control, (3) develop a quasi-standard multi-purpose wellhead power system in the size range of 3 to 8 MWe to fill the gap that presently exists in this area, and (4) maintain a program of exploratory research and technical assessments as needed. The general areas of study are: environmental issues, technology and know-how transfer, power system development, exploratory research, and software.

44953 (EPRI-GS–6380, pp. 29-40) **1987 EPRI survey of geothermal electric utilities.** Kruger, P. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The 1987 EPRI [Electric Power Research Institute] survey of estimated geothermal generating capacity by the nations's electric utilities shows a continued growth rate in installed capacity of about 15% per annum from 1976 through 1986. Estimates for future years at three levels of confidence have declined, relative to previous years, but continue to approach the growth curve for installed capacity. Averages of the cumulated data from the eleven annual surveys with several weighting functions indicates a range of forecasts (in MW) of 2,600 to 3,500 for 1990, 4,300 to 4,900 for 1995, and 8,100 to 9,500 for 2000. The corresponding extrapolations of the linear and exponential regression curves of the actual installed capacity are (in MW): 2,600 (linear) and 3,900 (exponential) for 1990, 3,400 and 8,600 for 1995, and 4,200 and 18,700 for 2000.

44954 (EPRI-GS–6380, pp. 43-50) **EPRI [Electric Power Research Institute] wellhead power system projects.** Hughes, E.E. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

EPRI's [Electric Power Research Institute] subprogram on geothermal wellhead power systems includes studies of resources, wells, and power conversion cycles and equipment. Current and recently completed projects in these areas are summarized in this paper. Field experiments and test programs are also summarized. These include upstream hydrogen sulfide removal, a gas/geothermal hybrid power system, and field data on radon as an in-situ tracer in geothermal reservoirs. One major design effort is in progress. It is the design of a modular wellhead binary power system for use by utilities as the first unit on any new geothermal field in the 300 to 450°F temperature range. This standardized power system would also be selected when 3- to 8-MWe increments of expansion would best meet needs for capacity addition, resource evaluation or increased experience with a power conversion system operating at a site.

44955 (EPRI-GS–6380, pp. 59-64) **Hybrid cycle experiment at Pleasant Bayou (RP1671-5).** Campbell, R.G. (Ben Holt Co., Pasadena, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Under contract to EPRI [Electric Power Research Institute], The Ben Holt Co. has refurbished and procured equipment to be used to demonstrate the hybrid cycle for electricity production from a geopressured well. Hybrid power systems that combine both gas and geothermal heat as input for power generation can produce more than 15 percent more electricity than the same amount of fuel and geothermal fluid used in separate power plants. The hybrid concept can also reduce the risk and cost of developing hydrothermal resources for power generation. For geopressured resource development, the hybrid cycle is the preferred means of energy production when electricity prices are relatively higher than gas prices. Because no field test of this concept has been performed, EPRI and the US Department of Energy (DOE) are jointly sponsoring a program to build and test a gas/geothermal hybrid at the Pleasant Bayou geopressured well in Texas. This paper describes the system, its design and procurement, its construction and operation, and hybrid cycle advantages.

44956 (EPRI-GS–6380, pp. 75-82) **Experience with wellhead generators.** Hiriart L., G. (Comision Federal de Electricidad (Mexico)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A brief description of the main features of small, wellhead, backpressure power plants, for geothermal generation is presented. The location and the well to which every one of the six power plants of Los Azufres is connected, is explained. A resumee of the statistics that describe the performance of every unit is presented per year and global. The accumulated experience during five years of operation is condensed in a list of problems, with their solution, that have been found in some particular pieces of equipment and also with the operation of the unit. A list of references that contain detailed information of those units is presented.

44957 (EPRI-GS–6380, pp. 83-86) **Coso update.** Sugine, S.S. (Los Angeles Department of Water and Power, CA (USA)); Moore, J.L. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In September 1981, the Los Angeles Department of Water and Power (DWP) and California Energy Company, Inc. (CECI) were the successful bidders for the principal Bureau of Land Management (BLM) parcels at the Cosco Known Geothermal Resource Area. In addition to this, CECI has agreements with the China Lake Naval Weapons Center (NWC) to develop the geothermal resource on both NWC acquired and withdrawn lands. CECI made the resource discovery with a well drilled in December 1981 on the NWC acquired lands. They should be in operation with a 30-MW unit by June or July 1987. DWP has drilled three wells on their BLM leases, and CECI has also drilled three wells on their BLM leases. DWP plans to operate a demonstration unit beginning in 1991, and to have commercial units in operation by the mid to late 1990's. CECI has three electricity sales contracts with Southern California Edison Company totalling 240 MW.

44958 (EPRI-GS–6380, pp. 87-90) **Northern Nevada's geothermal power plants.** Blockley, W. (Sierra Pacific Power Company, Reno, NV (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

During the last three years four geothermal power plants having a net capacity of 25 MW_e have started operation here in Northern Nevada. There are eight more plants in various stages of construction which could be on line within the next three years. Most of these plants will be modular units with a capacity of 10 MW or less. There is only one plant where a utility's unregulated subsidiary has an ownership interest; the other plants are owned and operated by developers. The total geothermal power plant capacity in Northern Nevada resulting from operation of these additional plants may approach 140 MW_e. A brief description of each of the plants and its location is given below.

44959 (EPRI-GS–6380, pp. 117-120) **EPRI [Electric Power Research Institute] geothermal project overview.** Berning, J.L. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

EPRI [Electric Power Research Institute] has been supporting the development of moderate-temperature hydrothermal reservoirs since 1974. Successful development of binary-cycle technology similar to the Heber Binary Project and Flexible wellhead systems could almost double the amount of energy available from these moderate temperature resources. EPRI continues to support the development of binary-cycle technology with research studies, field experiments, and equipment design efforts, along with direct technical and financial participation. This paper describes the following projects: Heber binary-cycle plant; the flash crystallizer separator; the downwell pump study; the geothermal binary-cycle simulator/analyzers; and the power plant data base.

44960 (EPRI-GS–6380, pp. 121-128) **Heber Binary Project operations and testing status.** Solomon, N.G. (San Diego Gas & Electric, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Heber Binary Plant has been in operation for two years and currently is in the demonstration phase of the Project. Since an extended outage during the summer and fall of 1986, the plant has operated steadily reaching a maximum generator output of 36 MW (gross) and 21 MW (net) with 4.9 Mlb/hr of brine flow from eight production wells. Test program activity during the last year emphasized low power plant performance testing and the continued collection of long term pump performance data. Recently, plant operation has been impacted by hydrocarbon booster pump availability. However, this problem is not expected to prevent the plant from ramping up in load to full power when the required brine production wells become available. In the near term, plant operations and testing will be concerned with automatic control and low power turbine performance.

44961 (EPRI-GS–6380, pp. 129-134) **Heber Binary Project operating lessons learned.** Fishbaugher, J.R. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Heber Binary-Cycle Geothermal Demonstration Power Plant, partly funded by EPRI [Electric Power Research Institute], is a 45 MWe generating plant operating in the Imperial Valley of Southern California. Plant construction and startup was completed during June 1985, and the project demonstration phase is in progress. EPRI objectives for the Heber project have been to develop the binary cycle technology for the generation of electric power from moderate temperature (up to 410F) geothermal resources. The Heber plant is expected to demonstrate the technical performance, the economic parameters, and the environmental suitability of the binary-cycle for a commercial-sized plant. The technical expectations for the Heber Binary Project have been generally realized for operations up to 50% power. Plant operating experience from startup in 1985 to mid-June 1987 is cataloged.

44962 (EPRI-GS–6380, pp. 135-144) **The current status of high temperature geothermal lineshaft pump technology.** Ellis, P.F. II (Radian Corporation, Austin, TX (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Geothermal resources with temperatures between 250°F and 360°F are prime candidates for binary cycle power production, and constitute about 80 percent of the power-capable resources in the United States. The successful exploitation of these resources requires reliable high capacity downwell brine pumps. An EPRI [Electric Power Research Institute] survey of downwell pump experience completed in April 1983 showed that the median endurance of high temperature pumps at that time was less than 1,000 rotating hours. This survey also indicated that breakthroughs had occurred and endurances of more than 4,000 hours were in the offing. Since that time, considerable new lineshaft pump experience has accumulated. Pump endurances in excess of 10,000 hours have been documented, but early failures continue to plague operations. Recent developments at the Heber Binary Plant indicate that most of these early failures can be eliminated through enhanced quality control. EPRI is currently conducting an update of the original survey to document the current and projected near-term status of downwell pumps. This paper presents preliminary results of that survey. It is emphasized that pump endurances in this paper are expressed in terms of rotating (operating) hours, rather than total time in the well.

44963 (EPRI-GS–6380, pp. 145-157) **Flash crystallizer field test: initial and recirculation test results.** Hurtado, R. (Instituto de Investigaciones Electricas, Altos (Mexico)); Jimenez, H.; Holguin, S.; Lopez, R.; Guillen, D.; Damian, F.; Bigger, J.E.; Berning, J.L. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In order to optimize the geothermal energy utilization, from high salinity brines, EPRI [Electric Power Research Institute] has designed and built and advanced concept flash-crystallizer. The field test is being conducted at the Cerro Prieto Geothermal Field by the IIE [Instituto de Investigaciones Electricas] in a cost-shared agreement with EPRI. Two separated series of test have been performed: (1) Venturi & Straight draft tube initial test, and (2) Venturi Draft tube recirculation test. Poor recirculation of seed in the reaction zone and high level of suspended solids in the clarified brine were experienced. An increment in the seed recirculation was experienced after a minor modification of the crystallizer vessel bottom. The test program will continue with this modification.

44964 (EPRI-GS–6380, pp. 160-172) **Automatic on line mechanical cleaning system for condensers and heat exchangers.** Grande, M. (Northern California Power Agency (NCPA), Healdsburg (USA)); Someah, K. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The on-line cleaning system for condensers and heat exchangers provides a positive means for automatic cleaning on a continuous basis while plant remains on stream and in its full operating condition. Condenser tube fouling contributes up to 50% of the total condenser tube heat transfer resistance. The penalties and the costs associated with the operation of a fouled condenser can include increased turbine heat rate and back pressure, increased operating and maintenance costs, reduced performance and power generation output, increased outages, and loss of plant availability. Foulants such as slime, bacterial matrix, algae, silt, scale, corrosion products, mud, sludge, etc., adhere to the heat transfer surfaces and gradually build on. They reduce efficiency of the best designed condenser/heat exchangers, induce localized corrosion of the condenser tubes, and eventually force a shutdown of the unit for manual cleaning. The problem could still exist even when using the most sophisticated water treatment available today. In this paper the various types of cleaning systems to reduce fouling are discussed. The Northern California Power Agency's experience is used to demonstrate the actual operating and maintenance savings associated with installing an on-line cleaning system at their geothermal power plants.

44965 (EPRI-GS–6380, pp. 219-234) **Validation results for a PC-based binary-cycle geothermal power plant simulator/analyzer.** Greenlee, T.L. (Engineering Systems & Sciences Corporation, Solana Beach, CA (USA)); Crouse, D.C. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The simulator/analyzer, as developed, can be used for (1) Engineering analyses of static/dynamic performance and design trade-offs, (2) Operator training and operating procedure evaluation, and (3) Binary cycle technology demonstration. Simulation predictions have been validated by comparison with actual transient and steady state data taken from the Heber Binary Project, a 46.6 MWe binary-cycle demonstration power plant in operation in Southern California. This paper documents the validation results. The simulation is accurate to within the uncertainty of the plant's process sensors. The heat exchanger models predict accurate results in both static and dynamic situations. They represent an accurate, low-order dynamic model of a supercritical once-through boiler using a hydrocarbon working fluid. The system wide static predictions of the model compare favorably with plant data and suggest a minor tuning effort for valve and pump characterizations should be undertaken. The ability of the simulator to replicate actual plant upset conditions is impressive.

1509 Geothermal Engineering

Refer also to citation(s) 44948, 44951

44966 (EPRI-GS–6380, pp. 51-58) **A statistical data base for US geothermal wells.** Henneberger, R.C. (GeothermEx, Inc., Richmond, CA (USA)); Sanyal, S.K. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A computerized data base of flow data for more than 500 US geothermal wells has been developed to study the statistical characteristics of well flow parameters. Measured flow rates, wellhead pressures and temperatures, and fluid enthalpies have been compiled, along with descriptive information. Three classes of wells are distinguished: steam, self-flowing hot water, and pumped. The measured flow parameters are subject to some bias and uncertainty due to interdependence, inconsistent data reliability, and nonrandom sampling, but sample sizes are sufficient for reliable statistical results. A series of crossplots and histograms is used to display graphically the parameter distributions. The data base is well-suited to serve as the basis for further, more detailed studies.

44967 (EPRI-GS–6380, pp. 111-114) **Geothermal chemistry.** Michels, D.E. (Don Michels Associates, Whittier, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Geochemical Engineering has become a prominent aspect of geochemistry. Resource development demands data for power cycle selection, plant design, fluid treatment and disposal. This data is best obtained in the stage of well testing normally devoted to reservoir engineering. Data gathering often gets short shrift because the users may not have been selected at the time wells flow. Design and construction are moved on, anyway, sometimes followed by inefficient operations, shutdowns, renegotiated contracts, and retrofits. Chemical technology is advanced enough that chemical surprises are no longer justifiable. However, collecting appropriate data is awkward. Partly this is because the authority to collect, the motivation to collect, and the opportunity to collect are not well coordinated within or between companies involved with the many aspects of development. Doing better involves getting chemical data more thoroughly and in well-coordinated ways. Interpretation of chemical data is better when done in coordination with other specialists, from reservoir engineers, to mechanical design specialists, to waste managers.

44968 (EPRI-GS–6380, pp. 197-208) **Magma energy for power generation.** Dunn, J.C. (Sandia National Laboratories, Albuquerque, NM (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Thermal energy contained in crustal magma bodies represents a large potential resource for the US and magma generated power could become a viable alternative in the future. Engineering feasibility of the magma energy concept is being investigated as part of the Department of Energy's Geothermal Program. This current project follows a seven-year Magma Energy Research Project where scientific feasibility of the concept was concluded. The project addressed five task areas: source location and definition, source tapping, magma characterization, material compatibility, and energy extraction. Work on these topics proceeded for seven years and culminated in a demonstration of many of the magma energy concepts in the molten zone of Kilauea Iki lave lake. Several highlights and major conclusions from the research project are briefly described below by task area and the current status of the engineering program is presented.

44969 (EPRI-GS–6380, pp. 209-218) **The Hot Dry Rock Program: Highlights and future.** Murphy, H. (Los Alamos National Laboratory, NM (USA)); Hendron, R.; Miller, J.; Dreesen, D. Electric

Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The most significant achievements in the last year were as follows. In May and June 1986, following successful sidetracking and redrilling of well EE-3A through seismically-detected fracture zones, the 30-day-long Initial Closed Loop Flow Test was conducted. Hot water at 192 C was produced at the surface at a rate equivalent to a thermal power of 10 MW. A new hydraulic fracture mapping method was developed. This method takes locations of fracturing events detected by downhole and surface seismometers and then treats the data statistically to determine the dips and strikes of the major fracture planes. Development of chemically reactive tracers continues. Several tracers have been identified, with first order reaction kinetics that vary over a narrow temperature range. By periodically injecting several such tracers, each with a different reaction temperature range, and determining the extend of reaction of each tracer in the production well, the movement of thermal fronts in a reservoir can be tracked with time. Borehole logging tool developments include slim-lining of existing tools, combining multiple measurements in a single tool (an example being 4-independent-arm caliper measurements combined with gamma detector and casing collar locator), and down-hole multiplexing.

44970 (LA–11647-MS) **Repair, sidetrack, drilling, and completion of EE-2A for Phase 2 reservoir production service.** Dreesen, D.S.; Cocks, G.G.; Nicholson, R.W.; Thomson, J.C. Los Alamos National Lab., NM (USA). Aug 1989. 67p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-7405-ENG-36. Order Number DE89015208/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Hot Dry Rock (HDR) geothermal energy well EE-2 at Fenton Hill, New Mexico, was sidetracked and redrilled into the HDR Phase II reservoir after two unsuccessful attempts to repair damage in the lower wellbore. Before sidetracking was begun, six cement slurries were pumped to plug the abandoned lower wellbore and to support the production casing where drilling wear was predicted and where sidetracking was to occur. This work and the redrill of EE-2A were completed in November 1987. Specifications were prepared for a state-of-the-art tie-back casing, which was procured, manufactured, and delivered to Fenton Hill in May 1988. The well was then completed in June 1988 for hot-water production service by cementing in a liner and the upper section of production casing and installing and cementing a tie-back casing string. 24 refs., 17 figs., 5 tabs.

1510 Direct Energy Utilization

44971 (NEI-DK–202) **Geothermal energy. Program evaluation.** Dansk Olie og Naturgas A/S, Copenhagen (Denmark). Jun 1983. 134p. (In Danish). Order Number DE89914690/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

Comparative evaluations and calculations regarding the feasibility of initiating district heating systems based on thermal energy conversion as opposed to coal firing. A cost benefit analysis is presented. A heat pump system in the Danish town of Thisted is examined with regard to the possibility of its utilizing an alternative heat resource to geothermal water. (AB).

1520 Geothermal Data and Theory

Refer also to citation(s) 44947, 46184

44972 (EPRI-GS–6380, pp. 93-100) **Trace elements overview.** Cobble, J.W. (San Diego State Univ., CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Calculations and chemical modelling has been carried out for As, B, and Hg in geothermal fluids. As primarily exists as gaseous and aqueous arsenous acid and its derivatives. The principal species of B are apparently gaseous and aqueous boric acid. Hg is transported largely as dissolved elemental Hg, Hg vapor, and gaseous HgS, depending upon the H_2S/H_2 ratio. Over 60 species, including two new species not previously known to exist, $As(OH)_3(g)$ and $HAsO_2Cl^-$, have been characterized. This summary is an overview of the recent calculations on the transport of three trace elements, As, B, and Hg in geothermal brines and steam. In the case of As, it also contains a summary of the latest experimental data on the solubilities of arsenous sulfide and volatilities of gaseous arsenous acid, $As(OH)_3$. These three important elements are observed in most geothermal fluids, ranging from parts per trillion for Hg to hundreds of parts per million for B, and all three have been found in brines, steam, and cooling tower liquids and sludge. All three of these trace elements, along with Cd, Sb, Se, and others, are known to be toxic at some level. Consequently, it is important to understand their brine and steam chemistry and to develop the chemical equilibria and thermodynamic equations involved. With such data, the transport of trace elements from any geothermal field can be calculated and correlated to specific geothermal plants, and potential hazards evaluated. Such modelling data are also very useful in proposing abatement procedures, if such are required. In general, thermodynamic data for many of the elements and species dissolved in high temperature brines and steam are not available, and must either be directly measured or estimated by theoretical means.

16 TIDAL AND WAVE POWER

1605 Environmental Aspects

44973 (ETSU-TID–4062-P2) **Prediction of post barrage densities of shorebirds. V. 2. Sediments.** UKAEA Harwell Lab. (UK). Energy Technology Div.; Ravensrodd Consultants Ltd., Taunton (UK). 1989. 101p. Order Number DE89914432/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

This report considers one component for a three part study into factors controlling bird numbers on the intertidal flats in estuaries around the south west peninsula of the UK. It deals with the grain size, organic content and shear strength of the sediments from 640 samples representing 43 separate sites from 7 estuaries. Since grain size is an important control of invertebrate faunal species and fence bird species, likely changes following closure of a tidal barrier are explored. (U.K.).

17 WIND ENERGY

44974 (SV-UP–1989-14) **Influence of the operating strategy on the economy of a wind-diesel plant. Some operating strategies for wind-diesel plants of the Aeskeskaer type and a program for simulating wind speed time series.** Borg, M. Swedish State Power Board, Vaellingby (Sweden). 14 Mar 1989. 53p. (In Swedish). Order Number DE89914800/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The report discusses the economy of a wind-diesel power plant with the system solution used on Aeskeskaer. In 1986, a simulation program was made for the wind-diesel power plant on Aeskeskaer. It proved necessary to make certain changes in this program in order to be able to show, through a number of simulations, that the program corresponds to the actual operating conditions on Aeskeskaer. Subsequently, cost estimates were made for different plant operating strategies. An estimate is also made of optimal component sizes and the overall size of the plant. The economic estimates in the report have been made both analytically and by means of simulations. The latter are particular to this system solution, but should also be possible for the analytical calculations to be used, at least partially, for other kinds of system solutions. A presentation is given of a program for how time series of wind speeds can be simulated. The procedure gives two possible final results. One possibility is a simulation that gives values which on average have a distribution that is approximately equivalent to the so-called Weibull distribution. The other possibility is, by means of time-consuming process, to adapt the values so that they correspond to the theoretical distribution. In

this case, the van der Hoven spectrum is multiplied by the mean wind speed in order to give the variation in wind speeds in time.

1704 Economics

44975 (CONF-871062–15) **Wind energy utilization. Status of research and development in the Federal Republic of Germany.** Stahl, W.; Windheim, R. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1987. 23p. From Windpower '87; 5-8 Oct 1987. Order Number DE89910941/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

The Federal Ministry of Research and Technology (BMFT) is supporting most of the R and D activities in the field of wind energy in the Federal Republic of Germany which are being carried out in projects. The general objective is to develop reliable wind energy conversion systems (WECS) and to stimulate the commercialization of wind power, particularly through demonstration projects. Activities range from the generation of electricity using WECS of less than 50 kW up to several megawatts to the modification of small and medium-sized machines for special applications. Other projects are concerned with detailed measurements of wind characteristics, basic research and the technical optimization of turbines. The following report mainly describes the support measures and policies of BMFT and concludes with a review of future funding policies for wind energy programmes in Germany. (orig.).

44976 (ETDE/CA-MS–M91-7-28-1988E) **Small power production in remote communities. A shared opportunity.** Department of Energy, Mines and Resources, Ottawa, ON (Canada). 1988. 116p. (MICROLOG–89-03117). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The production of electric power from small-scale, independently installed and operated power systems is relatively new in Canada, although in recent years small-scale wind and hydro systems have been installed across the country, several in remote communities. This manual is intended to facilitate the development of power sale and purchase agreements between small power producers and utilities who provide energy service in remote communities. It is based on small-hydro or wind power systems only. The manual presents an overview of the project development process and reviews the benefits, financial, social and economic, technical, and legal considerations of the small power producer and the utility. Basic technical information is provided in the appendix, as well as 3 case studies. A list of manufacturers and of small power producers' associations are included, as well as a glossary and the government approvals process. 3 figs.

1705 Environmental Aspects

44977 (ETSU-WN–5097-P1) **Social implications of a wind driven generator located in a residential area.** UKAEA Harwell Lab. (UK). Energy Technology Div.; Southampton Univ. (UK); Milton Keynes Development Corp. (UK). 1989. 166p. Order Number DE89914428/JAW. Available from NTIS (US Sales Only), PC A08.

The findings are presented of a series of investigations to monitor noise disturbance to local residents and the potential distraction to highway users of a wind driven generator. The site chosen was in Milton Keynes close to newly built housing and adjacent to a major city thoroughfare. The findings are presented for resident feedback, driver feedback and observational research. No identification of dangerous driver behaviour was encountered but for those households closest to the wind turbine, noise disturbances were reported. (U.K.).

1706 Wind Energy Engineering

Refer also to citation(s) 44975

44978 (DAF–212) **Development, installation and testing of a wind turbine diesel hybrid.** Dominion Aluminum Fabricating Ltd., Cooksville, ON (Canada). [1989]. 41p. (CE–02770). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A proposal is presented for demonstrating the mechanical and economic feasibility of using a hydrid system, comprised of a wind turbine and a diesel generator, for the purposes of power generation in isolated areas. Two systems, one electrically coupled and one mechanically coupled, would be designed and compared. A small scale demonstration system is proposed for installation at the Toronto Island Airport from which data will be obtained over a total working period of eight weeks. The data will be extrapolated to larger installations from which simulation studies will be carried out for particular Canadian sites and user load conditions. A cost analysis is also proposed, and will show what economic benefits would be realized by the installation of such systems at chosen sites. 3 figs.

44979 (EFI-TR–3543) **Dynamic simulation program for wind/diesel power plants.** Uhlen, K.; Ognedal, R. Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway). Oct 1988. 89p. (In Norwegian). Order Number DE89914734/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report describes mathematical models of different concepts for the design of wind/diesel power plants. A computer program for the implementation of these models has been developed, and a brief user's guide to it is given. An example of the application of the program is also shown. 4 refs., 46 figs.

44980 (ETSU-WN–0561-P4) **Effect of meteorological parameters on wind turbine behaviour - an analytical study.** UKAEA Harwell Lab. (UK). Energy Technology Div.; Cranfield Inst. of Tech., Bedford (UK). 1989. 43p. Order Number DE89914429/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

An analysis has been performed to assess the nature of the interaction of the atmospheric wind with a horizontal axis wind turbine. Although the analysis has concentrated on the in-plane motion of the blades and the consequent effects on shaft torque, this same analysis can be extended in a similar fashion to calculate the out-of-plane or coning motions of the blades. The most important factor governing the magnitude of the torque fluctuations is the ratio of the wind turbine diameter to the lateral scale of the turbulence. As this ratio increases the r.m.s. of the torque fluctuations decreases. The normalised r.m.s. of the torque is only weakly dependent on design tip speed ratio, incidence, and the aerofoil lift/drag characteristic. In order to reduce the problem to a reasonable level for solution by analytical means, several simplifying assumptions have been made. (author).

44981 (ETSU-WN–5053) **Synchronous/induction generator testing on the WEG MS-2.** UKAEA Harwell Lab. (UK). Energy Technology Div.; Wind Energy Group Ltd., Southall (UK). 1989. 107p. Order Number DE89914430/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

A comparative study is made on induction and synchronous generators both technically and by computer simulation. The practical measurements were performed on a 250 KW wind turbine and studied power quality and local grid voltage disturbances. No inherent difference in efficiency was found between the two generator configurations but the induction generator required power factor correction. (U.K.).

44982 (ETSU-WN–5091) **Options for variable speed operation of horizontal axis wind turbine generators.** UKAEA Harwell Lab. (UK). Energy Technology Div.; Wind Energy Group Ltd., Southall (UK). 1989. 104p. Order Number DE89914431/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The advantages and disadvantages of variable speed operation of horizontal axis wind turbine generators are quantified where possible. Among the attributes considered are increased energy capture, reduction in gearbox cost, noise, increased losses due to frequency conversion, increased structural costs, the cost of the actual variable speed generating equipment and a possible reduction in reliability. The comparisons are based on two detailed wind turbine designs, one of 250 KW and one of 2.4 MW. Further studies are desirable to resolve the remaining uncertainties. (U.K.).

44983 (PNL–6921) **Detailed analysis of the wake and free-flow characteristics at the Goodnoe Hills MOD-2 site.** Elliott, D.L.; Barnard, J.C. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 93p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89015203/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Wind data collected at nine meteorological towers at the Goodnoe Hills MOD-2 wind turbine site were analyzed to characterize the wind flow over the site both in the absence and presence of wind turbine wakes. Although previous studies have examined the wake and free-flow characteristics at the site, data collected in 1985 from nine towers permitted a much more detailed and accurate analysis than was previously possible. 13 refs., 25 figs., 7 tabs.

44984 (SERI/STR–217-3463) **A comparison of wind turbulence simulation models for stochastic loads analysis for horizontal-axis wind turbines.** Walker, S.N.; Weber, T.L.; Wilson, R.E. Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 33p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009442/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Four wind turbine turbulence codes, the Pacific Northwest Laboratory (PNL) Rotational Code, the PNL Simulation Code, the Holley Code, and the Sandia National Laboratories Code, were examined. Hub-height simulations were made with each code and were compared to hub-height wind data from the vertical plane array of anemometers at the Howden 330-kW horizontal-axis wind turbine (HAWT). Blade tip simulations were made with each code and were compared to rotational wind data taken from the Howden-330 kW HAWT. The PNL Rotational Code was given an overall rating of satisfactory for large wind turbine applications and an overall rating of good for small wind turbine applications. The PNL Simulation Code was given a rating of good when used with large turbines and a rating of very good when used with small turbines. The Holley Code and the Sandia Code were given ratings of good and satisfactory, respectively, for both large and small wind turbine applications. The Sandia Code could be upgraded if documentation were made available. Further upgrades for any of the codes would require major revision.

44985 (SERI/TR–215-3195) **Some significant results from testing a Remote Multiplexing Unit (RMU) for temperature-induced errors.** Wells, C.V. Solar Energy Research Inst., Golden, CO (USA). Jun 1989. 24p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-83CH10093. Order Number DE89009432/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A key item of equipment used to acquire research data while testing wind turbines is the Remote Multiplexing Unit (RMU). To more adequately analyze and report data in the DOE Wind Program, and to provide the uncertainties associated with such data, performance data were needed on RMUs, especially in terms of their behavior under the influence of temperature and the rate of change in temperature. A special test was conducted on one RMU in 1986, with particular attention paid to the strain gage and voltage signal conditioning cards. This report presents some significant findings from the analysis of the test data. The information can be used to describe the uncertainties that are to be applied to wind energy research data acquired through RMU-based data acquisition systems. Operational recommendations suggested by the results include using longer warm-up times for the demultiplexing unit and possibly heating the RMU for operation at lower temperatures. 10 refs., 10 figs., 4 tabs.

20 ELECTRIC POWER ENGINEERING

Refer also to citation(s) 44601

44986 (OH/RD–87-314-K) **Interim Task Force report on high temperature superconductivity.** Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 49p. (MICROLOG–89-02648). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The recent discovery of high temperature superconductivity (HTSC) at transition temperatures up to 90 K is an important scientific achievement. In April 1987, an HTSC task force was formed at Ontario Hydro to monitor the technology development resulting from this discovery, to assess its impact, and to identify future opportunities. The existence of superconducting material, mainly YBaCuO, at transition temperatures of up to 90K, has been confirmed (the crystal structure of YBaCuO is presented); on the other hand, the existence of a room temperature superconductor is uncertain. While the experimental knowledge on the 90K material is growing rapidly, there is no generally accepted theoretical explanation of its behavior. The material's low critical current density may be a major hurdle in the optimization process; moreover, the fabricating and processing challenges presented by the HTSC material suggest that the period of development for applications in the power system may extend for 10 years or more. Despite this, the task force felt that the material may eventually be optimized and fabricated and have an impact on the supply and demand of electrical energy. A preliminary analysis of the possible advantages of HTSC machines over conventional machines in key areas of the power system operation is presented. The task force recommends a strategy that calls for close monitoring of research trends, feasibility assessment, and ranking of potential applications. It further recommends that Ontario Hydro undertake a 2-year work program with major tasks in information gathering, application studies, and material technology; the budgeting of such a program is presented. 2 figs., 13 tabs.

2001 Power Plants and Power Generation

Refer also to citation(s) 44425, 44454, 44894, 44978, 45002, 45003, 45009, 45057, 45112, 45193, 45312, 45473, 45492, 45517

44987 (ANL/EES-TM–375) **Examining advanced fossil-fueled technologies with a utility capacity-planning model.** VanKuiken, J.C.; Hamilton, B.P. Argonne National Lab., IL (USA). Apr 1989. 36p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE89015177/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report describes the second part of a two-phase study that investigated the capabilities of capacity-planning models to characterize advanced, fossil-fuel-fired, electrical generating technologies in least-cost expansion plans. The overall objective was to identify a modeling tool that would give the US Department of Energy's Office of Fossil Energy the capability to analyze a broad spectrum of issues that are evolving in the capacity-planning area, using an approach with procedures similar to those followed by electric utilities. In Phase 1, capacity expansion models were reviewed and selected. In Phase 2, the chosen model was exercised with selected case studies, results were examined, and sensitivities to technology characterizations and modeling procedures were identified. Phase 2 began early in 1986, and a final draft of this report on the Phase 2 work was prepared in April 1987. The technology characterizations and cost estimates provided therein reflected the best estimates as of mid-1986. Although these characterizations and cost estimates have changed since this work was originally performed, the purpose of this report is still relevant – to demonstrate the capabilities and sensitivities of capacity planning models in analyzing advanced fossil energy technologies. Therefore, because the goal is to emphasize the procedural aspects of expansion planning rather than present any final conclusions about the advanced technologies, the cost and performance estimates have not been updated for this final publication of the report. 29 refs., 3 figs., 14 tabs.

44988 (ANL/FE–89/2) **Fouling of gas turbine passages.** Ahluwalia, R.K.; Im, K.H. Argonne National Lab., IL (USA). Apr 1989. 82p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. Order Number DE89015213/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Fouling of gas turbine passages is of concern when ash bearing fuels are used. This report evaluates the various aspects of the anticipated fouling problem when clean coal in dry or slurry form is used as a turbine fuel and solid/semi-molten particles of flyash, residual char and reacted/unreacted sulfur sorbents are entrained in the combustion gas. For the purpose of analysis, fouling is posed as a two-step process with particle delivery to the blade surface

constituting the first step and adhesion of the contacting particles constituting the second. Models of Brownian diffusion, thermophoresis, eddy impaction, and inertial impaction are formulated for determining the rates and mechanisms of particle delivery to the pressure and suction surfaces of turbine blades. Adhesion characteristics of flyash under gas turbine conditions are inferred from experimental data. Based on these models and other experimental data, a number of variables are identified that affect either the delivery rate of the particles or the adhesion characteristics. These are conveniently classified in three categories: physical and chemical aspects of coal feedstock (coal grind and pre-cleaning, slurry composition and additives, mineral matter composition and distribution), combustion environment (slurry atomization, stoichiometry, residence time, fluid mechanics, dilution air), and gas turbine environment (turbine inlet temperature, blade cooling, passage aerodynamics). A qualitative/semi-quantitative discussion is offered on the roles of flyash size distribution, coal-water mixture slurry atomization, coal combustion, physical and chemical beneficiation of coal, blade cooling, turbine inlet temperature, sorbent injection, and deposition cleanability. 34 refs., 25 figs., 10 tabs.

44989 (EGG-M–28487) **The densification of refuse-derived fuel: A state of the art assessment.** Steverson, E.M.; Goldsberry, J.A.; Mayberry, J.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-8909109–1: 21. biennial conference of the Institute for Briquetting and Agglomeration, 27-30 Sep 1989). Order Number DE89011099/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The state of the art of densification technology, as applied to producing densified Refuse-Derived Fuel (dRDF) was assessed and evaluated. Aspects of the technology, such as performance, economics, pacing problems, operational practice, and available equipment were addressed. Most of information presented came from development and operational studies on the pellet mill. While the technical problems associated with densifying RDF have been overcome to the point that densification can be an operational success, the cost of densifying is prohibitive in most current markets. 1 ref., 2 figs., 4 tabs.

44990 (EPRI-ER–6428) **Research planning study of fiber-optic sensors: Final report.** Electric Power Research Inst., Palo Alto, CA (USA); Tennessee Valley Authority, Chattanooga, TN (USA). c Aug 1989. 136p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The pace and breadth of fiber optic sensor research and development are enormous. This study identifies potential applications of fiber optic sensors in power systems, evaluates the present technology, suggests development of sensors for applications, and identifies areas of research. Among the numerous applications studied, several were suggested for additional research. 10 refs.

44991 (EPRI-GS–6467) **Boiler tube failure: Correction, prevention, and control: Final report.** Dimmer, J.P. Electric Power Research Inst., Palo Alto, CA (USA); General Physics Corp., San Diego, CA (USA). c Jul 1989. 513p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Manual is for guidance in implementing formalized boiler tube failure (BTF) reduction programs, and for training of power plant management, engineering, operation and maintenance personnel in the "controllable" aspects of BTF correction, prevention and control. It is primarily programmatic in content and firmly based on the philosophical concepts and technical information presented in EPRI Reports: CS-3945, "Investigation and Correction of Boiler Tube Failures", CS-4629, "Interim Consensus Guidelines on Fossil Plant Cycle Chemistry", and CS-5164, "Guideline Manual on Instrumentation and Control for Fossil Plant Cycle Chemistry". The Manual, including a generic corporate philosophy statement, was developed and used in the training of personnel from sixteen utilities participating in EPRI's Project RP1890-7, "Boiler Tube Failure Reduction Program". The development of specific program statements by each utility, prior to training, was demonstrated to be essential for company-wide program direction, and acceptance by plant personnel. The Manual includes five stand-alone training modules. Module 1 describes six essential programmatic requirements for implementing a formalized BTF Reduction Program. Four additional function-specific modules are presented; one each for management, engineering, operation and maintenance personnel.

44992 (MSC–X7801/1) **Cariboo woodwaste study.** Minister of State for Cariboo, Victoria, BC (Canada). 1989. 176p. (MICROLOG–89-02971). Available from British Columbia Legislative Library, Government Documents Division, Parliament Buildings, Victoria, BC, CAN V8V 1X4; $65.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A study was conducted to determine the feasibility of using wood waste as a fuel for power generation and co-generation applications in the Cariboo Development Region, British Columbia. After completing a regional inventory of waste availability, the study focused on Williams Lake as one of the most opportune communities, where the volume of wood waste available is sufficient to fuel a 60 MW thermal plant. In addition to power sales to British Columbia Hydro, there is potential in Williams Lake for the sale of 3-8% of the thermal plant's energy as heat or steam to adjacent sawmills. A further opportunity may exist for the sale of about 20% of the plant's steam capacity and about 25% of the electric power to a proposed wood product board plant. Site selection and pollution control are discussed. Furnace designs have been compared; the capital cost premium for a fluidized-bed furnace is not economically justified. Alternative uses of wood waste have been considered too problematic from the environmental point of view. In order to evaluate the economic viability of the project, two financial models were developed. One consists of a stand-alone plant obtaining wood waste from local sawmills (capital cost $113.2 M). The other consists of the same plant, but with additional capital investment and associated conveyor facilities between some of the sawmills and the plant (capital cost $119.2 M). Once in operation, the plant would directly employ an estimated 34 persons, and 60 other jobs could be expected to be created in support and related businesses. The price of purchase of electric power by B.C. Hydro is critical in order to achieve a sufficient return on equity. 6 refs., 24 figs., 59 tabs.

44993 (NBNRE/FW–006U192) **Hatching and early rearing of salmon and trout in warm water from a power plant.** Roach, S.A; Hooper, W.C.; Blouw, L.M.; Gilbert, J.C. New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Fish and Wildlife Branch. 1983. vp. (CE–02734). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Condenser cooling water from the Grand Lake coal-fired power plant has been utilized to hatch and rear Atlantic salmon and trout during the winter months; summer rearing, using surface waters cooled by ground water, has also been successful. To take full advantage of the power plant's condenser cooling water, it is desirable to accelerate salmonid growth during the earliest stages in their life history. During 1981-82, a pilot facility was constructed, comprising a hatchery building, portable raceways, salmon ponds and water supply systems, identified as the Grand Lake Aquaculture Station (GLAS). Atlantic salmon hatched in January were reared to 1.8 g and 3.2 g by June of 1981 and 1982, whereafter they were grown to 70 g and 90 g one-year smolts at the GLAS. Brook trout cannot be grown to 40 g by June or 300 g by October unless, perhaps, condenser cooling water is thermally enriched to 17 C from February until May. Lake trout cannot tolerate fluctuating temperature or temporary warm water; they were grown to 8 g by June a size sufficent, when trasferred to a conventional cold water facility, to attain 30 g by October. Landlocked salmon was the most successful species to be reared, attaining a fall fingerling size of 41 g by September. This demonstrates the economic and bilogical feasibility of the process; moreoverr, existing conventional fish culture facilites can potentially double their production utilizing transferred fingerlings from a power plant-based production facility. The cost of utilizing condenser cooling waters for hatching and early rearing instead of conventional boiler systems represents considerable savings. Further research is

now underway, using enriched condenser cooling water and photoperiod control, to produce Atlantic salmon smolts and marketable brook trout in only 10 months. 51 refs., 22 figs., 20 tabs

44994 (OH/RD–87-315-K) **Replica inspection of high temperature components. Life assessment, Lakeview unit 4.** Clark, M.A. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 65p. (MICROLOG–89-02649). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

As part of an overall life assessment program, replica inspection of selected high temperature components in the coal-fired generating station in Lakeview, Unit 4, has been carried out by the Metallurgical Research Department of Ontario Hydro. The replica work is intended to identify areas of components that are experiencing high temperature creep degradation that is manifested in the form of creep cavities or microcracking, as well as to identify other damage mechanisms. Creep damage was discovered in only three general areas: the main steam to high pressure steam chest welds, the intermediate pressure (IP) steam chest, and the IP loop pipes. Re-inspection of these areas is recommended at regular intervals. Other defects in turbine components have been examined and found to be mostly thermal fatigue related and many were associated with manufacturing or repair flaws. 30 figs., 1 tab.

44995 (OH/RD–D88-0010) **Hydro-Quebec's future generating and transmission system.** Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 47p. (MICROLOG–89-03170). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This brochure shows the current status of the generating and transmission facilities of Hydro-Quebec, reviews the generating stations and bulk transmission lines planned up to 2006, and presents the possibilities for the longer-term development of the system. Summaries are given for each long-term development choice, including opting for hydroelectricity, the use of 735 kV overhead bulk transmission lines, underwater vs. overhead crossings, the rescheduling of construction for export, improvement of the reliability of the system, the effects of electrical installations on health, research on the release of mercury into reservoirs, polychlorinated biphenyls, the use of herbicides to control vegetation, the effects of electrical pheonomena, and the cumulative effects on the environment. An additional brochure provides information about the laws governing projects, agreements on cooperation reached with other parties, and procedures the utility applies during project execution. 2 figs., 3 tabs.

44996 (VTT-TUTK–577) **Improvement of the operation safety of total energy units used for producting heat and electric energy.** Kytoe, M.; Nylund, N-O. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). May 1989. 62p. (In Finnish). Order Number DE89787740/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

In a total energy unit based on the use of a diesel cogenerator the waste heat of the engine, recovered from both exhaust gases and cooling water, is utilized in addition to electric energy. The availability and available long-term efficiency of the total energy unit was determined in the experiments. The reliaility and the long-term efficiency were improved and the service interval was lengthned with the aid of different modifications. This publication introduces experiments with light fuel oil. The capacity of the unit used in the experiments is 32 kW. The total energy unit will be equipped with a spark-ignition engine modified from a diesel engine and the experiments will be continued with PLG. The maximum total efficiency of the test unit is 74-78% with a minimum load of at least 1/3 of the nominal load and with a clean exhaust gas heat exchanger. The efficiency reduces by 1-4 percentage units during an operating cycle of about a week, if automatic water sweeping is used. At full load (30 kW) the reduction is highest, at 1/3 load the exhaust gas heat exchanger does not get dirty in practice and the efficiency hardly decreases. This was achieved by cleaning the exhaust gas heat exchanger automatically by water sweeping during the operation and by transferring as much as possible of the waste heat to the cooling water and further in the liquid-liquid heat exchanger to the heat system. Without water sweeping the efficiency of a supercharged engine reduced by 3-7% percentage unit and that of a non-charged engine by 1-2 percentage units more, due to a higher soot content of the exhaust gases. The exhaust gas emissions from the total energy unit are normal for a diesel engine. Compared to fixed combustion plants, expecially the NO_x values are high. Chances for lengthening the maintenance interval are good. The operating life of the engine oil is a decisive factor.

44997 **Eddy current inspection of ferromagnetic materials using pulsed magnetic saturation.** Dodd, C.V. (Oak Ridge National Lab., Oak Ridge, TN (US)); Deeds, W.E.; Chitwood, L.D. pp. 206 of Fossil power plant rehabilitation. American Society for Metals, Metals Park, OH (1989). (CONF-890219–: International conference on fossil power plant rehabilitation: trends in life management and reliability technology, 27 Feb - 1 mar 1989).

A pulsed eddy-current system has been designed and developed for nondestructive evaluation of ferromagnetic steam generator tubing from the bore side. A large current pulse is sent through a driver coil to produce magnetic saturation all the way through the wall of a tube. The magnitude and length of the pulse can be increased to saturate thicker tubes, or shortened for very thin sections of ferromagnetic materials. The controlling computer, which may be either a PC-AT or a IBM System 9000, can analyze, display and store the data in real time. The system has demonstrated the capability to detect small flaws located near the outside of thick ferromagnetic tubing in the presence of other artifacts on the tube outside diameter.

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Refer also to citation(s) 44417, 45007, 45381, 45399, 46102, 46106

44998 (EPRI-GS–6423-Vol.1) **1989 symposium on stationary combustion nitrogen oxide control: Volume 1.** Electric Power Research Inst., Palo Alto, CA (USA). c Jul 1989. 552p. Sponsored by Electric Power Research Institute. (CONF-890318–Vol.1: Joint symposium on stationary combustion nitrogen oxide control, 6-9 Mar 1989). Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The 1989 Joint Symposium on Stationary Combustion NO_x Control was held in San Francisco, California, March 6–9, 1989. This Symposium, jointly sponsored by EPRI and EPA, had as its objective the exchange of information regarding recent technological and regulatory developments pertaining to stationary combustion NO_x control in the United States and abroad. Topics covered during the Symposium included: low-NO_x combustion development; coal-, oil-, and gas-fired boiler applications; flue gas treatment; fundamental combustion studies; and environmental and regulatory issues. The Symposium Proceedings is published in two volumes. Individual projects are processed separately for the data bases.

44999 (OH/RD–87-158-K) **FGD waste characterization/ disposal study.** Golomb, A. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 80p. (MICROLOG–89-02653). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In 1985, as part of the overall federal-provincial program to combat acid rain, the Ontario government tightened its emission limits on acid rain precursors from Ontario Hydro's coal-fired stations. To address one of the various control options available, Ontario Hydro launched an environmental assessment program to investigate retrofitting of flue gas desulfurization (FGD) equipment at selected coal-fired stations over a 20-year period. From a review of FGD literature and information supplied by existing FGD facilities, an assessment has been made of design and operational problems of closed loop operation and related water balance problems of wet FGD process alternatives. Also, technology for the treatment of FGD process wastewaters to meet environmental regulations has been reviewed. Based on available information, typical physical and chemical characteristics of potential solid wastes from Ontario

Hydro coal-fired stations are described for four candidate FGD processes (Limestone Slurry Scrubber, Dual Alkali, Lime Spray Dryer, and Limestone Injection). Solid waste handling options are considered for each FGD system reviewed. For all four systems, there is a need for monitoring and treatment of leachate from landfilled solid wastes. 33 refs., 8 figs., 34 tabs.

45000 (OH/RD–87-309-K) **Smoke and soot control in buildings housing metalclad switchgear.** Filter, R.; Jarv, T. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 69p. (MICROLOG–89-02605). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Smoke, soot and pressure rise attendant to arcing faults inside metalclad switchgear compartments can cause prolonged station outages and can increase the severity of fault damages. Over 75 tests were carried out to investigate methods of limiting the damages caused by arcing faults inside metalclad switchgear. Ventilation system enhancements involving the use of a specially designed false ceiling, associated ducting, fans, and sealing of the switchgear were assessed with simulated and actual faults inside a transmission station building mock-up. Test results demonstrate that the new ventilation system design, along with metalclad sealing, can be effective in limiting smoke and soot propagation through a transmission station building during and immediately after an arcing fault. With the newly developed false ceiling design, improved personnel safety is provided through better control of hot toxic gases and aerosol resulting from an arcing fault. With the new ventilation system, rapid access to corridors and metalclad sections is possible so that clean-up after a fault can proceed almost immediately. It is concluded that the false ceiling, ventilation system enhancements, and switchgear sealing are effective and can be immediately applied. 11 refs., 18 figs., 15 tabs.

45001 (PB–89-203699/XAB) **Overview of the regulatory baseline, technical basis, and alternative control levels for nitrogen oxides (NOx) emission standards for small steam generating units. Final report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. May 1989. 48p. (EPA–450/3-89/13). Available from NTIS, PC A03/MF A01.

See also PB–89-203707.

This report provides a summary of the technical data used in developing proposed new source performance standards (NSPS) for small industrial-commercial-institutional steam generating units (small boilers). The report focuses on nitrogen oxides (NOx) emissions from boilers firing coal, oil, and gas with heat input capacities of 100 million Btu/hour or less. Conclusions are drawn from the data regarding the performance of technologies available to reduce NOx emissions. Alternative control levels are then chosen based on the conclusions drawn from the data.

45002 (PB–89-203707/XAB) **Model boiler cost analysis for controlling nitrogen oxides (NOx) emissions from small-steam generating units. Final report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. May 1989. 40p. (EPA–450/3-89/16). Available from NTIS, PC A03/MF A01.

See also PB–89-203699.

This report presents estimates of the cost and cost effectiveness associates with controlling nitrogen oxides (NOx) emissions from small coal-, oil-, and gas-fired industrial-commercial-institutional steam generating units (small boilers). The report was prepared during development of proposed new source performance standards (NSPS) for small boilers (boilers with heat input capacities of 100 million Btu/hour or less).

45003 (PB–89-203731/XAB) **Projected impacts of alternative new source performance standards for small industrial-commercial-institutional fossil fuel-fired boilers. Final report Final report.** Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. May 1989. 151p. (EPA–450/3-89/017). Available from NTIS, PC A08/MF A01.

This report presents projected national environmental cost and energy impacts of alternative sulfur dioxide (SO_2) and particulate matter (PM) air emission standards for new small industrial-commercial-institutional steam generating units (small boilers) firing coal, oil, and natural gas. The analysis examines projected impacts in the fifth year following proposal of the standards. The report was prepared during development of proposed new source performance standards (NSPS) for small boilers.

45004 (SI-R–851203-4) **Combustion of impregnated biomass.** Benestad, C.; Jebens, A.; Tveten, G. Senter for Industriforskning, Oslo (Norway). Jun 1988. 25p. (In Norwegian). Order Number DE89914766/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report deals with a pilot project comprising an investigation done on the combustion of biomass using calcium acetate as an additive. The flue-gas samples were analysed and tested both regarding tar, PAH (Polycyclic Aromatic Hydrocarbons), and mutagenicity. The flue-gas concentrates were analysed for acid components, and also the toxicity was tested by means of the Microtox-test method. The experimental results show that the the biomass using calcium acetate as an additive, did not reduce the discharged organic micro pollutions from the combustion. 7 figures, 10 tables.

45005 **Spark decomposition of SF_6.** Griffin, G.D. (Oak Ridge National Lab., TN (USA). Health and Safety Research Div.); Sauers, I.; Kurka, K.; Easterly, C.E. *IEEE Transactions on Power Delivery (USA),* 4(3): 1541-1551 (Jul 1989).

Gas-insulated systems employing SF_6 are utilized in a variety of applications in power delivery systems. Because electric arcs, sparks or corona can decompose SF_6 into by-products having chemical properties different from SF_6, environmental concerns arise regarding inadvertent human exposures to electrically-decomposed SF_6. Biological assays in our laboratory using mammalian cell culture systems have revealed that SF_6, spark-decomposed under specific experimental conditions, can produce cell death. Chemical analysis of spark-decomposed SF_6 has identified the major decomposition pathways and by-products. Biological testing of individual by-products or by-product mixtures has indicated that these major decomposition products may not account for the majority of the cell killing effects seen in our assays. Further experiments have suggested that S_2F_{10} may be produced and accumulate under our specific decomposition conditions and that this compound may be a major contributor to the observed cell lethality. On the basis of the biological activity the authors have observed in our spark-decomposed SF_6 samples, testing of samples from commercial facilities and assays of decomposed gas after ameliorative treatments would both be appropriate investigations.

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Refer also to citation(s) 44995, 45588, 46339

45006 (EFI-TR–3562) **Hybrid method in power system state estimation.** Gjelsvik, A. Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway). Dec 1988. 36p. Order Number DE89914731/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In standard weighted least squares state estimation, linear least squares problems arise as subproblems, often solved by the normal equations. The hybrid method combines the normal equations approach with that of orthogonal transforms to give better numerical stability. The report reviews the analytical formulation of the hybrid method and gives an outline of an actual implementa- tion in state estimator program at the State Power Board (Statkraft) in Oslo. 18 refs., 1 fig., 1 tab.

45007 (EPRI-EL–6237) **PCB [polychlorinated biphenyl] residues in transformer carcasses: Final report.** Rouse, T.O.; Raymond, C.T.; Fessler, W.A. Electric Power Research Inst., Palo Alto, CA (USA); General Electric Co., Pittsfield, MA (USA). c Aug 1989. 79p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This project had three objectives. The first was to assess the population of PCB-containing transformers remaining in service in the US in 1988. While this could not be done with great precision, it appears that the population of oil-filled transformers containing > 50 μg PCB/g oil has decreased by some 15% since 1982 and that the population of askarel-filled transformers has decreased by some 40% in the same time period. This progress could be continued and accelerated if additional reliable and accepted routes for disposal of PCBs contained in transformers would be developed. The second and third objectives of this project have been to examine two simplified approaches to this end. The second objective was to determine if, by draining PCB-containing oil from transformers and refilling with PCB-free oil, a level of PCBs below 50 ppM (μg/g oil) could be reached with assurance. It appears that reclassification of "PCB-contaminated" oil-filled transformers (50–500 μg PCB/g oil) of all ratings by draining and refilling could be done routinely. The third objective was to determine the level of residual PCBs left on the metallic surfaces of askarel-filled transformers which, if these units were refilled with PCB-free mineral transformer oil, would have resulted in concentrations of <50 μg PCB/g oil. It appears that cleaning the surfaces of the metallic components, after careful separation and disposal of the liquid and impregnated solid insulations, to a level of 400 μgPCB/100 cm^2 would result in transformer carcasses of all sizes which would contain less PCBs than would be found were these transformers to have contained oil at the level of 50 μgPCB/g oil. 7 refs., 6 figs., 9 tabs.

45008 (IVO-A–03/89) **Mechanical vibration caused by wind.** Lampio, E. Imatran Voima Oy, Helsinki (Finland). May 1989. 74p. (In Finnish). Order Number DE89787752/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Energy transferred into the power transmission lines by wind and energy absorbed into the conductor are of equal level in the standing wave state of the transversal vibration of the conductor. I have earlier presented the conditions with which this equilibrium will be achieved. This report includes mathematical equations which describe the relative strains concerning the individual strands of a conductor when the antinode value of the vibration state or the vibration angle of the node is known. These mathematical equations are based partly on pure geometric deformations and partly on hypotheses deduced from the results obtained from experiments, and the equations work well as long as the strands will not slip at any point of contact. The results from my research concerning the strains of the outermost strand layer and those of the next to the outermost as well as the numerous measurements carried out in various countries both with test spans and in operating conditions in open terrain give reference to the fact that most of the conductor vibration amplitudes are so negligible that statistically there is no considerable slippage between the strands.

45009 (OH/R–88-124-K) **Biological Research Section annual report, 1987.** McMillan, A.C. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 24p. (MICROLOG–89-02671). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Biological Research Section is a unit within the Ontario Hydro Research Division functionally responsible for conducting directed basic research and scientific investigations related to the biological sciences in support of Ontario Hydro's planning and operational activities. This document provides an overview of major activities undertaken by the Section during 1987, highlights some major accomplishments and describes major areas of endeavour planned for 1988.

45010 (OH/RD–87-4-K) **Gassing of paper wrapped conductors.** Janis, W.J. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 49p. (MICROLOG–89-02654). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Thirteen, 38 cm diameter disk winding models of paper-wrapped conductors, 8 assembled with non-thermally upgraded, power transformer winding insulation and 5 with upgraded (cyanoethylated) insulation, were subjected to thermal overloads under a variety of pressure, moisture content, and electrical stress conditions. Short term gas emissions were >99% water vapor while long term (100 h) emissions also included CO_2, CO, H_2, CH_4, and C_2H_4. Wet insulation (6% moisture) degraded significantly in 100 h at 150^{0}C while dry insulation (<0.5% moisture) did not. The gassing onset temperature can be calculated from the system pressure and paper water content, and gassing rate data indicate that gradual rather than sudden overloading in field operations would minimize gassing and dry the windings. 15 refs., 6 figs., 13 tabs.

45011 (OH/RD–87-305-K) **Toronto Cecil TS [transformer station] GIS [gas insulated substation] /cable interface arresters power frequency overvoltages and energy rating.** Pillai, P. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 16p. (MICROLOG–89-02620). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Field tests were conducted at Toronto Cecil Transformer Station to determine the power frequency and surge voltages at the gas-insulated substation(GIS)/cable and oil feed pipe interfaces and the propagation characteristics of pipe-type cables. Measurements indicated that the polarizing cell loop inductance is about 89 μH at low frequencies. Power frequency overvoltages of 1.8 kV and 120 V respectively across the GIS/cable and oil feed pipe interfaces were derived from measurements for a fault current of 30 kA. Models for calculating power frequency and surge voltages at the interfaces and transient energy dissipation in interfacesurge arresters have been developed. 4 refs., 6 figs., 3 tabs.

45012 (OH/RD–87-310-K) **A fault current diverter (FCD) for indoor metalclad switchgear.** Filter, R.; Jarv, T. Ontario Hydro Research Div., Toronto, ON (Canada). [1989]. V (MICROLOG–89-02594). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Laboratory tests were carried out in the summer of 1987 to assess the potential of the Ontario Hydro developed fault current diverter in providing arcing fault protection for indoor metalclad switchgear in transmission station buildings. These tests demonstrated that if suitable firing protocols are developed, fault diversion techniques can provide a high degree of protection against smoke and soot damages caused by arcing faults. It is recommended that R&D into a fault current diverter for indoor metalclad switchgear, along with suitable diverter firing protocol, be initiated. 7 refs., 8 figs., 2 tabs.

45013 (OH/RD–88-28-K) **Ottawa Carling TS [transformer station]. Grounding system studies.** Pillai, P. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 12p. (MICROLOG–89-02598). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Current injection tests were conducted at Ottawa Carling Transformer Station to measure the ground potential rise and touch and step potentials. Soil resistivity at the station was also measured. The ground potential rise and touch and step potentials were found to be within safe limits for an ultimate high voltage station fault current of 10 kA. Models were developed to generalize the results. 3 refs., 3 figs., 3 tabs.

45014 (OH/RD–88-49-K) **25 Hz system load measurements. Hamilton Gage TS [transformer station].** Berube, G.R. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 60p. (MICROLOG–89-02602). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Measurements were performed to characterize the load variations occurring on the 25 Hz system at Gage Transformer Station (TS) to assist in planning studies into future 25 Hz supply options. In addition, harmonic distortion measurements were conducted at Gage

TS (25 Hz) and Beach TS (60 Hz) to aid in the development of detailed specifications for frequency conversion equipment planned for this area. Comparisons are made between the measured results and applicable standards for harmonic distortion limits. 8 refs., 28 figs., 12 tabs.

45015 (OH/RD–88-68-K) **Seed bank estimates for the McCowan road simulated right-of-way project.** Brown, D. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 20p. (MICROLOG–89-02576). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Two methods commonly used to estimate the species composition of the buried seed bank, feed extraction and seedling emergence, were tested at the McCowan road right-of-way site. The methods gave estimates of the seed bank which were considerably different. The relative merits of the 2 methods, and the potential usefulness of a seed bank determination in the planning of the initial vegetation management on a newly established right-of-way, are also discussed. 31 refs., 3 tabs.

45016 (OH/RD–88-96-K) **Toronto Cecil TS. [generating station] Grounding system tests.** Pillai, P. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 10p. (MICROLOG–89-02574). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Simulated fault current tests were conducted at Toronto Cecil Transformer Station to measure the station ground potential rise, touch voltages and pipe cable shielding efficiency at power frequency. The measured results were found to agree reasonably well with the previously calculated values. The station ground potential rise and touch potential for an ultimate high voltage fault current of 3 kA are well under safe limits. A revised model to include the impedance of the oil feed pipe is presented. 3 refs., 3 figs., 2 tabs.

45017 **Directional harmonic overcurrent relay device.** Atwater, P.L.; Jacobs, M.L. To Department of the Interior, Washington, DC. USA Patent 7-349,736. 9 May 1989. 28p. Available from NTIS, PC A03/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

This invention relates to a single- or multiple-phase directional relay device for monitoring of low levels of harmonic currents in an electric power system. The relay of this invention also employs adjustable taps for conveniently setting the minimum level of harmonic current corresponding to a condition of overcurrent, and provides a selection of time-overcurrent characteristic operating curves to delay the operation of the trip means once a condition of harmonic overcurrent has been detected. The relay is advantageous in that extremely low levels of harmonic overcurrent can be monitored so as to or prevent damage to a power system, and in that two harmonic currents may be monitored simultaneously.

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Refer also to citation(s) 44596, 45141, 46510

45018 (DOE/OSTI–8200-R52) **Nuclear reactors built, being built, or planned, 1988: Revision 52.** USDOE Office of Scientific and Technical Information, Oak Ridge, TN (USA). Aug 1989. 84p. Sponsored by U.S. DOE Nuclear Energy. Order Number DE89014401/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This document contains unclassified information about facilities built, being built, or planned in the United States for domestic use or export as of December 31, 1988. The Office of Scientific and Technical Information, US Department of Energy, gathers this information annually from Washington Headquarters and field offices of DOE, from the US Nuclear Regulatory Commission, from the US reactor manufacturers who are the principal nuclear contractors for foreign reactor locations, from US and foreign embassies, and from foreign governmental nuclear departments. The book is divided into three major sections: Section 1 consists of a reactor locator map and reactor tables. Section 2 includes nuclear reactors that are operating, being built, or planned. Section 3 includes reactors that have been shut down permanently or dismantled.

45019 (IAEA-TECDOC–491, pp. 73-78) **Analysis of integral experiments by the Monte Carlo method.** Majorov, L.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Description of the MCU code, based on the Monte Carlo method, is given. This code was used for calculation of the vapour effect of the reactor of the Chernobyl nuclear power plant. The results of the verification of this code on the basis of integral critical experiments are given in the appendix. (author). 13 refs, 1 fig., 8 tabs.

2101 Power Reactors, Non-breeding, Light-water Moderated, Boiling Water Cooled

Refer also to citation(s) 44723, 44777, 44816, 45036, 45130, 45131, 45138, 45139, 45140, 45143, 45144, 45145, 45148, 45150, 45151, 45152, 45153, 45154, 45160

45020 (CONF-8908119–1) **Understanding the boiling water reactor limit cycle.** March-Leuba, J. Oak Ridge National Lab., TN (USA). 1989. 12p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From BWR stability symposium; 10-11 Aug 1989. Order Number DE89016233/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper presents an interpretation of the physical mechanisms involved in the development of limit cycle oscillations in boiling water reactors (BWRs). Based on this interpretation, approximate correlations for some oscillation parameters are developed and shown to be largely independent of the particular reactor operating condition. The stability of the limit cycle is also studied in this paper. It is shown that the BWR limit cycle may become unstable and bifurcate. The bifurcation process leads to aperiodic (chaotic) behavior of the reactor power and causes the peak oscillation powers to be larger than those from a nonbifurcated limit cycle. 7 refs., 6 figs., 1 tab.

45021 (EGG-M–88311) **Aging assessment and mitigation for major LWR [light water reactor] components.** Shah, Y.N.; Ware, A.G.; Conley, D.A.; MacDonald, P.E.; Burns, J.J. Jr. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 48p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC07-76ID01570. (CONF-8810155–49: 16. water reactor safety information meeting, 24-27 Oct 1988). Order Number DE89016216/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper summarizes some of the results of the Aging Assessment and Mitigation Project sponsored by the US Nuclear Regulatory Commission (USNRC), Office of Nuclear Regulatory Research. The objective of the project is to develop an understanding of the aging degradation of the major light water reactor (LWR) structures and components and to develop methods for predicting the useful life of these components so that the impact of aging on the safe operation of nuclear power plants can be evaluated and addressed. The research effort consists of integrating, evaluating, and updating the available aging-related information. This paper discusses current accomplishments and summarizes the significant degradation processes active in two major components: pressurized water reactor pressurizer surge and spray lines and nozzles, and light water reactor primary coolant pumps. This paper also evaluates the effectiveness of the current inservice inspection programs and presents conclusions and recommendations related to aging of these two major components. 37 refs., 7 figs., 3 tabs.

45022 (IAEA-TECDOC–491, pp. 31-39) **Comparison of calculated and measured reactivity coefficients for light water**

reactor lattices. Johansson, E. (Studsvik Nuclear, Nykoeping (Sweden)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The cell and assembly multigroup transport theory burnup code CASMO in its latest version, CASMO-3, combined with a 70-group nuclear data library, a modified variant of an earlier CASMO library, has been tested against data from experimental facilities. The tests reported deal with reactivity coefficients for light water reactor lattices and, to some extent, with related parameters, in particular the resonance absorption in U238. (author). 14 refs, 5 figs, 5 tabs.

45023 (IAEA-TECDOC–491, pp. 39-68) **Temperature effect analysis in LWR lattices - Thermal cross-section shapes and qualification through French integral experiments.** Santamarina, A. (CEA Centre d'Etudes Nucleaires de Cadarache, 13 - Saint-Paul-lez-Durance (France). Dept. des Reacteurs a Eau). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The reactivity temperature coefficient is analyzed for light water reactor lattices. Qualification through French integral experiments leads to adjustments in the thermal cross-section curve shapes for U-235 and U-238. (author). 22 refs, 29 figs, 10 tabs.

45024 (IAEA-TECDOC–491, pp. 94-114) **Resonance absorption and coolant void reactivity coefficient in tighter pitch lattices.** Ishiguro, Y. (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

This paper reviews the present status of the nuclear data needed for analysis of high conversion light water reactors with tighter pitch lattices, through sensitivity analysis, cell burnup benchmark calculation and comparison of the conventional methods with Monte Carlo calculation, (author). 32 refs, figs and tabs.

45025 (NUREG/CR–4667-Vol.6) **Environmentally assisted cracking in light water reactors: Semiannual report, October 1987–March 1988.** Shack, W.J.; Kassner, T.F.; Maiya, P.S.; Park, J.Y.; Ruther, W.E. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Argonne National Lab., IL (USA). Aug 1989. 65p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-31109-ENG-38. (ANL–89/10-Vol.6). Available from NTIS, PC A04/MF A01 - GPO - OSTI.

This report summarizes work performed by Argonne National Laboratory on environmentally assisted cracking in light water reactors during the six months from October 1987 through March 1988. The stress corrosion cracking (SCC) of Types 304, 316NG, 347, and CF3M cast stainless steels (SSs) was investigated by means of slow-strain-rate, crevice-bent-beam, and fracture-mechanics crack-growth-rate tests in high-temperature water. The effects of temperature and water chemistry on the crack growth behavior of Type 136NG and sensitized Type 304 SS were determined in long-term fracture-mechanics tests. The influence of dissolved copper and organic impurities on the SCC of sensitized Type 304 SS was also investigated. Fatigue tests are being conducted on Type 316NG SS in air at room temperature to provide baseline data for comparison with results that will be obtained in high-temperature water. The investigation of the susceptibility of several heats of different grades of low-alloy ferritic steels to transgranular SCC in slow-strain-rate tests was continued. 8 refs., 21 figs., 10 tabs.

45026 (NUREG/CR–5287) **Closeout of NRC bulletin 87-01: Thinning of pipe walls in nuclear power plants.** Foley, W.J.; Dean, R.S.; Hennick, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Events Assessment; Parameter, Inc., Elm Grove, WI (USA). Aug 1989. 50p. Sponsored by Nuclear Regulatory Commission. (PARAMETER/NRC–178). Available from NTIS, PC A03/MF A01 - GPO - OSTI.

Documentation is provided in this report for the closeout of NRC Bulletin 87-01 regarding monitoring the thickness of pipe and component walls in high-energy single-phase and two-phase carbon steel piping systems of nuclear power plants. Both safety-related and non-safety-related systems are included in the monitoring program. The bulletin required five (5) actions by licensees and holders of construction permits. Complete closeout of the bulletin for 119 affected facilities and conclusions are based on Generic Letter (GL) 89-08. This GL requires written assurance that the licensing basis continues to be met by high-energy carbon steel piping systems subject to erosion/corrosion. Background information is provided in the Introduction and Appendix A.

45027 (NUREG/CR–5322) **Detection and characterization of indications in segments of reactor pressure vessels.** Cook, K.V.; Cunningham, R.A. Jr.; McClung, R.W. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Oak Ridge National Lab., TN (USA). Aug 1989. 31p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. (ORNL/TM–11072). Available from NTIS, PC A03/MF A01 - GPO - OSTI.

Studies have been conducted to estimate flaw density in segments cut from light water reactor (LWR) pressure vessels as part of the Oak Ridge National Laboratory's Heavy-Section Steel Technology (HSST) Program. Segments from the Hope Creek Unit 2 vessel and the Pilgrim Unit 2 vessel were purchased from salvage dealers. Hope Creek was a boiling water reactor (BWR) design and Pilgrim was a pressurized water reactor (PWR) design. Neither were ever placed in service. Objectives were to evaluate these LWR segments for flaws with ultrasonic and liquid penetrant techniques and to compare the results with current assumptions related to probabilistic risk assessment. Both objectives were successfully completed. Ultrasonic techniques beyond those required by the 1986 edition of the ASME Boiler and Pressure Vessel Code were necessary for the detection and reporting of the detected discontinuities. Extra care and analysis must be exercised when conducting ultrasonic examination through cladding. The detection of the discontinuities in the arbitrarily selected sections implies that the Marshall report estimates (and others) are nonconservative for such small flaws. 8 refs., 9 figs.

45028 (ORNL/TM–10902) **Physical characteristics of GE [General Electric] BWR [boiling-water reactor] fuel assemblies.** Moore, R.S.; Notz, K.J. Oak Ridge National Lab., TN (USA). Jun 1989. 161p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC05-84OR21400. Order Number DE89015645/JAW. Available from NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

The physical characteristics of fuel assemblies manufactured by the General Electric Company for boiling-water reactors are classified and described. The classification into assembly types is based on the GE reactor product line, the Characteristics Data Base (CDB) assembly class, and the GE fuel design. Thirty production assembly types are identified. Detailed physical data are presented for each assembly type in an appendix. Descriptions of special (nonstandard) fuels are also reported. 52 refs., 1 fig., 6 tabs.

45029 (PNL-SA–16973) **Wall thinning in nuclear piping: Status and ASME Section XI activities.** Bush, S.H. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 27p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8908125–4: Post-SMIRT conference No. 2, 21-22 Aug 1989). Order Number DE89016822/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Wall thinning due to wet steam is a well-known phenomenon in both fossil and nuclear power plants; however, the widely reported wall thinning and failure of a feedwater line in the Surry Power Plant was quite unexpected because it occurred in single-phase liquid water. Since the Surry failure, wall thinning had been reported on other nuclear plants, demonstrating single-phase erosion-corrosion

to be a generic issue. Critical parameters influencing wall thinning in single-phase liquid water are: alloy composition of the pipe; degree of turbulence in a given location; pH level; oxygen content, linear flow velocity; and temperature. Other factors may influence rate of attack and type of attack; e.g., uniform wall thinning, slot-type attack, or highly localized wall thinning. The USNRC has requested action by the ASME Codes, specifically Section XI. This paper discusses the wall-thinning problem and current program, particularly at EPRI, aimed at its definition and resolution and the Section XI resolution. The Section XI plan is based on the maximum utilization of the available data generated by EPRI, by the USNRC and by the utilities. Section XI covers nondestructive examination (NDE) related to where and how often to examine and with what tools, e.g., ultrasonic or radiography. In addition, the issue of wall-thinning evaluation analogous to flaw evaluation is covered. It is hoped that there will be reduction in Section XI levels of weld examinations to partially compensate for added requirements of NDE to detect wall thinning. 9 refs., 15 figs., 2 tabs.

45030 (PNL-SA–16974) **Failure modes and mechanisms in nickel alloys: Primarily austenitic stainless steel.** Bush, S.H. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 25p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8908125–5: Post-SMIRT conference No. 2, 21-22 Aug 1989). Order Number DE89016823/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Austenitic stainless steels and higher nickel alloys such as the Inconels are used extensively in the chemical and nuclear industries. This review will concentrate on their behavior in nuclear reactors because of the availability of information to the author. Emphasis is given to the failure modes and mechanisms occurring in the context of causal mechanisms and the implications of alloy composition. Major use is made of the austenitic steels both AISI 304 and 316 in United States nuclear plants. This is true for both boiling water reactors (BWRs) and pressurized water reactors (PWRs). Over the years there have been many failures in these materials where failure is defined as cracking, leaking, and, rarely, catastrophic breakage. This review will examine failure mechanisms such as stress corrosion cracking, both transgranular and intergranular, fatigue, including vibrational and thermal, and other corrosion-related failures. 16 refs., 12 figs.

45031 (REG/G–1.85-Rev.26) **Materials code case acceptability ASME Section 3, Division 1: Regulatory Guide 1.85: Revision 26.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research. Jul 1989. 18p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

Section 50.55a, "Codes and Standards," of 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities," requires, in part, that components of the reactor coolant pressure boundary be designed, fabricated, erected, and tested in accordance with the requirements for Class 1 components of Section III, "Nuclear Power Plant Components," of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code or equivalent quality standards. This regulatory guide lists those Section III ASME Code Cases oriented to materials and testing that are generally acceptable to the NRC staff for implementation in the licensing of light-water-cooled nuclear power plants.

45032 RETRAN02/MOD3 modeling of the Kuosheng Unit 1 MSIV full isolation startup test. Wang, Jongrong; Chen, Yisheng; Wang, Songfeng. *Transactions of the American Nuclear Society (USA),* 57: 349-351 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Kuosheng nuclear power plant, the second nuclear power station of Taiwan Power Company (TPC), has two units of a General Electric Company designed boiling water reactor BWR/6 with a rated core thermal power of 2894 MW and rated core flow of 3.832×10^4 t/h (2.347×10^4 lb/s). The nuclear steam supply system consists of two recirculation loops and four main steam lines. Before the plant went into commercial operation, a series of power tests were conducted at both units to ensure the design adequacy of the system. The main steam isolation valve full isolation (MSIVFI) was one of the tests designed to (a) functionally check the proper operation of the MSIVs at selected power levels, (b) determine reactor transient behavior during and following simultaneous full closure of all MSIVs, and (c) determine the closure time of the MSIVs. The MSIV isolation was initiated by pulling fuses F6A and F6B in the control room panel. Test data were recorded by the plant transient recorder (STARTREC) and were adopted for comparisons. The objective of the present study was to simulate the Kuosheng Unit 1 MSIVFI test using the RETRAN02/MOD3 code as part of the overall qualification efforts of the plant model. In addition to data comparison, parameters sensitive to plant-specific RETRAN model development were also investigated.

2102 Power Reactors, Non-breeding, Light-water Moderated, Non-boiling Water Cooled

Refer also to citation(s) 44723, 44777, 45021, 45022, 45023, 45024, 45025, 45026, 45027, 45029, 45030, 45031, 45056, 45083, 45099, 45113, 45115, 45128, 45130, 45131, 45133, 45139, 45140, 45143, 45144, 45145, 45148, 45149, 45150, 45151, 45152, 45153, 45154, 45156, 46185

45033 (CNEN-DR-GAPS-NT–02/88) **Angra-1 probabilistic safety study-phase B.** Fernandes Filho, T.L.; Gibelli, S.M.O. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). Dept. de Reatores. May 1988. 89p. (In Portuguese). Order Number DE89636466/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

This study represents the Phase B of the Angra-1 Probabilistic Safety Study and is the the final report prepared for the IAEA under Research Contract No. 3423/R2/RB. The three main items covered in this report are the establishment of interim safety goals, analysis of Angra-1 operational experience and development of emergency procedures to address severe accidents. For establishment of interim safety goals a methodology for calculating consequences and risks associated to the Angra-1 operation was developed based on the available data and codes. The proposed safety goals refer to the individual risk of early fatality for people living in the vicinity of the plant, colective risk of cancer fatalities for people living near the plant, the propobability of core melt occurrence and the probability of dominant accident sequences. (author).

45034 (CNEN-DR-GAPS-RA–02/88) **Utilization of "RASO" for a historical survey of Angra-1 power from 26.10.88 for updating the inventory calculation.** Guimaraes, A.C.F.; Goes, A.G. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Dec 1988. 23p. (In Portuguese). Order Number DE89636468/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The "RASO", an activity and operational situation report for Angra 1, is transmitted daily by phone to CNEN by inspectors living at Angra 1 site, anal shows the parameters about the operational status of the nuclear power plant. In the period of 26.10.88 to 04.12.88 a discretized power serie was determined for greater time intervals than the original serie, and then new concentrations were calculated using origem 2 computer code. (author).

45035 (CNEN-DR-GAPS-RT–01/88) **Generic nuclear power plant component failure data bank.** Araujo Goes, A.G. de; Gibelli, S.M.O. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Nov 1988. 88p. (In Portuguese). Order Number DE89636469/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

This report consist in the development of a generic nuclear power plant component failure data bank. This data bank was implemented in a PC-XT microcomputer, IBM compatible, using the Open Access II program. Generic failure data tables for Westinghouse nuclear power plants and for general PWR power plants are presented. They are the final product of a research which included a preselection and a selection of data collected from the available sources in the library of CNEN (National Nuclear Energy Commission) and from the CIN/CNEN (Neclear Information Center). Futhermore, a proposal of evaluating models of average failure rates of pumps and valves are also presented. Through the electronic data bank one can easily have a generic view of failure rate ranges as well as

failure models foe a certain component. It is very importante to develop procedures to collect and store generic failure data that can be quickly accessed, in order to update the Probabilistic Safety Study of Angra-1 and to used in studies which may have component failures of nuclear power plant safety systems. In the future, data specialization can be achieved by means of statistical calculations involving specific data collected from the operational experience of Angra-1 nuclear power plant and the generic data bank. (author).

45036 (CONF-8908125–1) **Thermal-shock experiments with flawed clad cylinders.** Cheverton, R.D.; Bryson, J.W.; Alexander, D.J. Oak Ridge National Lab., TN (USA). [1989]. 18p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400;AC12-76SN00052. From Post-SMIRT conference No. 2; 21-22 Aug 1989. Order Number DE89016069/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The life expectancy of LWR pressure vessels is influenced by a reduction in fracture toughness that is the result of radiation damage. As the fracture toughness decreases, the probability of propagation of preexisting flaws (sharp, crack-like defects) in the wall of the vessel increases. The probability of propagation is also influenced by the type of loading condition and the type of flaws that might exist. A loading condition of particular concern is referred to as pressurized thermal shock (PTS), and a flaw of particular concern for PTS loading conditions is a shallow surface flaw. A sudden cooling (thermal shock) of the inner surface of the vessel results in relatively high tensile stresses and relatively low fracture toughness at the inner surface. In addition, the attenuation of the fast-neutron fluence also results in relatively low fracture toughness at the inner surface. Under some circumstances, this combination of high stress and low toughness at the inner surface makes it possible for very shallow surface flaws to propagate. The PTS issue has been under investigation for quite some time, but thus far possible beneficial effects, other than thermal resistance, of the cladding on the inner surface of the vessel have not been included in the analysis of flaw behavior. This document discusses this effect of cladding on surface flaws and crack propagation.

45037 (DOE/ET/34013–14) **The evaluation and demonstration of methods for improved nuclear fuel utilization: Eleventh progress report, January 1, 1987–September 30, 1988.** Smith, G.P.; Hayduk, D.M. Combustion Engineering, Inc., Windsor, CT (USA); Arkansas Power and Light Co., Little Rock, AR (USA). Jul 1989. 36p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-79ET34013. (CEND–431). Order Number DE89015169/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The objective of this Department of Energy sponsored project is to demonstrate the extended burnup capability for Combustion Engineering 16 x 16 fuel. This demonstration has been performed in the Arkansas Nuclear One Unit 2 (ANO-2) reactor located near Russellville, Arkansas. It is a 2815 MWt pressurized water reactor (PWR) owned and operated by Arkansas Power and Light Co. ANO-2 is the first Combustion Engineering reactor to utilize the 16 x 16 fuel design. The extended burnup objective will be realized by demonstrating that the current fuel design is capable of increasing batch average exposure at discharge to 52 GWd/MtU and by evaluating advanced fuel designs with the potential to offer increased performance margins over the current design at similar discharge exposures. Analyses are included to assure that the extended burnup objective can be realized with conventional and low leakage fuel management schemes. This report is the eleventh progress report and covers the progress made from January 1, 1987, through September 30, 1988. During this period, test Assembly D040, which contains standard fuel rods and rods with advanced fuel designs, completed its irradiation and was discharged at EOC-6 after five cycles of exposure. The assembly and individual fuel rods were examined in detail in the ANO-2 spent fuel pool. Following the examinations, a selected group of standard fuel rods with advanced fuel designs were inserted into a shipping basket to await shipment to a hot cell for additional examinations.

45038 (EPRI-NP–6455) **Field studies on intergranular attack: Final report.** Richards, J.E. Electric Power Research Inst., Palo Alto, CA (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Service Technology Div. c Aug 1989. 159p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Field data from operating pressurized water reactors (PWRs) were compiled to investigate possible chemistry causes of intergranular attack (IGA). Data from two plants were contributed by plant staffs. Additional data at three other plants, including one without IGA, were gathered on-site as part of the project. Quantities of contaminant hideout return did not appear to correlate with occurrence of IGA. Alkaline crevice chemistry, as evidenced by cation-to-anion ratios, was seen in plants having IGA, while the one plant without IGA appeared to have neutral crevice chemistry. 2 refs., 69 figs., 8 tabs.

45039 (IAEA-TECDOC–491, pp. 85-93) **Advanced PWRs (APWRs) and related safety considerations.** Broeders, C.H.M. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Neutronenphysik und Reaktortechnik); Kuesters, H.; Mateeva, A. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The paper describes the main characteristics of a tight lattice advanced pressurized water reactor (APWR) with mixed-oxide (MOX) fuel with emphasis to nuclear data sensitivities and calculational procedures. It is concluded that certain cross-section data of actinides and fission products are not yet known with sufficient accuracy, and some problems in the calculational procedures are identified. (author). 23 refs, 1 fig., 4 tabs.

45040 (INIS-BR–1575) **Transient performance of flow in PWR reactor circuits.** Hirdes, V.R.T.R.; Carajilescov, P. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (In Portuguese). (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89636470/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Generally, PWR's are designed with several primary loops, each one provided with a pump to circulate the coolant through the core. If one or more of these pumps fail, there would be a decrease in reactor flow rate which cause coolant phase change in the core and components overheating. The present work establishes a simulation model for pump failure in PWR's and the SARDAN-FLOW computes code was developed, considering any combination of such failures. Based on the data of Angra I, several accident and operational transient conditions were simulated. (author).

45041 (IPEN-PUB–246) **Analysis of the refloding pressure drop measurements.** Freitas, R.L. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Feb 1989. 15p. (In Portuguese). Order Number DE89636471/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

These work draw a theoretical-experimental comparison from the total pressure drop results during the reflooding phase of a loss of coolant accident of a PWR. It was verified from this evaluation that the void fraction and the pressure drop models for the two-phase flow, including the subcooled boiling influence and the configuration, dont permit a satisfatory prediction of the experimental data. These differences can occur from the fact that the existing models are stablished, the majority, for the different conditions than those for the reflooding events. (author).

2103 Power Reactors, Non-breeding, Graphite Moderated

Refer also to citation(s) 45086, 45089, 45124, 45136, 45146, 45148, 45152

45042 (IAEA-TECDOC–491, pp. 23-31) **Effect of fuel burnup and cross-sections on modular HTGR reactivity coefficients.** Lefler, W. (General Atomics Co., San Diego, CA (USA)); Baxter, A.; Mathews, D. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987).

In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The temperature dependence of the reactivity coefficient in a prismatic block Modular High-Temperature Gas-Cooled Reactor (MHTGR) design is examined and found to be large and negative. Temperature coefficient results obtained with the ENDF/B-V data library were almost the same as results obtained with the earlier versions of the ENDF/B data library usually used at GA Technologies Inc. (GA) in spite of a significant eigenvalue increase with the ENDF/B-V data. The effects of fuel burnup and arbitrarily assumed cross section variations were examined and tabulated. (author). 2 refs, 7 figs, 5 tabs.

45043 (Juel–2266) **The two-dimensional reactor dynamics program TINTE. Pt. 2. Examples of application.** Gerwin, H. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung. Feb 1989. 87p. (In German). Order Number DE89915124/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The TINTE code system deals with the nuclear and the thermal transient behaviour of the primary circuit of an HTGR taking into consideration the mutual feedback effects in two-dimensional r-z geometry. In Part One of this report (Juel-2167) the initial equations were compiled and methods of solution discussed. In an appendix to this second part they are completed by some supplementary points. The TINTE code construction and a detailed input description will be discussed in Part Three. The Part Two shows examples of application, especially a comparative calculation of dynamic experiments performed at the AVR. A good agreement between calculational and experimental results is found. Further examples show the flexibility of TINTE: first of all, individual moduli of TINTE are used to find a solution to a thermofluid problem. In addition TINTE is used to demonstrate the mutual feedback between nuclear and thermal processes in process heat reactors, including those with natural convective conditions, without any control rod movement. (orig.).

45044 (UCID–21738) **Technical evaluation report of the Fort St. Vrain final draft upgraded technical specifications.** Kimura, C.Y. Lawrence Livermore National Lab., CA (USA). 12 Jul 1989. 33p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-7405-ENG-48. Order Number DE89015184/JAW. Available from NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.

This report is a technical evaluation of the final draft of the Fort St. Vrain (FSV) Upgraded Technical Specifications (UT/S) as issued by Public Service of Colorado (PSC) on May 27, 1988 with subsequent supplemental updates issued on June 15, 1988 and August 5, 1988. It has been compared for consistency, and safety conservatism with the Fort St. Vrain (FSV) Updated Final Safety Analysis Report (FSAR), the FSV Safety Evaluation Report (SER), the Facility Operating License, DPR-34, and all amendments to the Facility Operating License issued as of June 1, 1988, and Appendix A to the Operating License DPR-34, Technical Specifications. Because of the age of the plant, no supplements to the Fort St. Vrain SER have been issued since the original SER was not issued as a WASH or a NUREG report. This made it necessary to review all amendments to the Facility Operating License since they would contain the safety evaluations done to support changes to the Facility Operating License. The upgraded Fort St. Vrain Technical Specifications were also broadly compared with the latest Westinghouse Standard Technical Specifications (WSTS) to assure that what was proposed for Fort St. Vrain was consistent with the latest NRC staff practices for standard technical specifications.

2104 Power Reactors, Non-breeding, Otherwise Moderated Or Unmoderated

Refer also to citation(s) 44671, 45084, 45109, 45111, 45135, 45158

45045 (AECL–9182) **Air oxidation of UO_2 fuel. Chalk River studies.** Hastings, I.J.; Novak, J. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Apr 1986. 17p. (CONF-860417–: 3. international symposium/workshop on irradiated fuel storage, 8-10 Apr 1986). Order Number DE89635534/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The air oxidation at 175-400 degrees Celcius of unirradiated and irradiated UO_2 fuel fragments was characterized by apparent activation energies of 140 +- 10 and 120 kJ/mol, respectively. There was a small enhancement in rate of apparent weight gain for irradiated compared with unirradiated fragments up to about 300 degrees Celcius; from 300-400 degrees Celcius there was no significant difference in oxidation rate. Air availability had a strong effect on rate of weight change above 300 degrees Celcius. The oxide particle size range, 1-20 μm, did not differ significantly from 300-400 degrees Celcius. A deliberately-defected, irradiated, CANDU UO_2 fuel element, three months out of reactor, was heated in air at 400 degrees Celcius. After 4 h, the maximum diametral increase was about 6%; releases of I-131 and Kr-85 were 10^{-6} of inventory.

45046 (AECL–9326) **ELESTRES: performance of nuclear fuel, circumferential ridging, and multiaxial elastic-plastic stresses in sheaths.** Tayal, M. Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations. Oct 1986. 7p. (CONF-861026–: Topical meeting on CANDU fuel, 6-8 Oct 1986). Order Number DE89635537/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The finite element code ELESTRES models the two-dimensional axisymmetric behaviour of a CANDU fuel element during normal operation. The main focus of the code is to estimate temperatures, fission gas release, and axial variations of deformation/stresses in the pellet and in the sheath. Thus the code is able to predict details like stresses/strains at circumferential ridges. This paper describes the current version of ELESTRES. The emphasis is on a recent addition: multiaxial stresses in the sheath near circumferential ridges. For accuracy in the critical region, a fine mesh is used near the ridge. To keep computing costs low, a coarse mesh is used near the midplane of the pellet. Predictions of ELESTRES show good agreement with abouth 80 measurements of fission-gas-release. In this paper, we also present ELESTRES predictions of hoop strains in sheaths, for two irradiations: element ABS and bundle GB. For both irradiations, predictions, compare favourably with measurements. An illustrative example shows that near circumferential ridges, bending contributes to multiaxial stresses in the sheath. This can have a significant effect on sheath integrity, such as during stress-corrosion-cracking due to power-increases, or during corrosion-assisted-fatigue due to power cycling.

45047 (AECL–9329) **Rating of element closure welds and its influence on fuel reliability.** Sejnoha, R.; Valli, G.; Ceccotti, G.; Magnoli, L. Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations. Oct 1986. 19p. (CONF-861026–: Topical meeting on CANDU fuel, 6-8 Oct 1986). Order Number DE89635538/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A high performance standard of CANDU fuel, and similarly of CIRENE fuel is possible only if the frequency of fuel element failures due to incomplete welds is kept very low. Weld rating, i.e. the relative length of sound weld line, is used to characterize the weld completeness. Metallography is used for quantative determination of the weld rating. The nature of the metallographic inspection method, together with the affordable sample size and the very low acceptable weld failure rate, make a statistical approach to the evaluation of the weld ratings necessary. The paper outlines a statistical method of weld rating assessment. The method links the probability of finding discontinuities in metallographic sections, with the distribution of discontinuities in a statistical sample of welds. It presents the results in the form of a weld rating distribution graph. Applications of the method are discussed. Its use is shown for three batches of CIRENE development welds.

45048 (AECL–9330) **Transport mechanisms of uranium released to the coolant from fuel defects.** Manzer, A.M. Atomic Energy of Canada Ltd., Sheridan Park, ON (Canada). CANDU Operations. Oct 1986. 21p. (CONF-861026–: Topical meeting on CANDU fuel, 6-8 Oct 1986). Order Number DE89635539/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Fuel performance at domestic CANDU-600s, Point Lepreau and Gentilly, has been very good, with only a small number of fuel defects releasing uranium to the coolant. The in-core monitoring on

these early fuel defects using the delayed neutron system, provides some insight into uranium transport mechanisms and how they influence signal trends. Better understanding of these mechanisms, will assist the station operator in responding to trend changes and will ultimately provide guidance in assigning removal priorities should several fuel defects occur simultaneously. The average delayed neutron signal of all channels is the key parameter for monitoring fuel performance in-core, and should be regarded as an early warning indicator of fuel performance problems.

45049 (AECL–9439) **Comparison of calculated and experimental values of In/Mn and Lu/Mn ratios in CANDU-type lattices.** Craig, D.S. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Dec 1987. 22p. (CONF-870424–: American Nuclear Society international topical meeting on advances in reactor physics, mathematics and computation, 27-30 Apr 1987). Order Number DE89635541/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The In-116/Mn-56 and Lu-177/Mn-56 activation ratios have been calculated for a number of CANDU-type lattices using the integral transport method with the WIMS and RAHAB codes, and the In/Mn ratio using the Monte Carlo method with the MCNP code. The WIMS and MCNP values of the In/Mn ratio are in reasonable agreement and give confidence in the methods used to calculate the flux in the 1 eV region. However, the variation in the ratio of calculated to experimental values of the In/Mn ratio is so great that it is impossible to make any useful conclusion about the accuracy of the ENDF/B-V data for In-115. Similarly there is a large variation in the agreement between calculated and experimental values of the Lu/Mn ratio. It is not possible to draw any conclusion about the accuracy of the ENDF/B-V data for Lu-176.

45050 (INFO–0253-2) **Microcomputer based program for predicting heat transfer under reactor accident conditions. Volume II. Appendices.** Cheng, S.C.; Groeneveld, D.C.; Leung, L.K.H.; Wong, Y.L.; Nguyen, C. Atomic Energy Control Board, Ottawa, ON (Canada). Jul 1987. 238p. Order Number DE89635545/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

In FORTRAN for IBM PC AT/XT or compatible computer.

A microcomputer based program called Heat Transfer Prediction Software (HTPS) has been developed. It calculates the heat transfer for tube and bundle geometries for steady state and transient conditions. This program is capable of providing the best estimated of the hot pin temperatures during slow transients for 37- and 28-element CANDU type fuel bundles. The program is designed for an IBM-PC AT/XT (or IBM-PC compatible computer) equipped with a Math Co-processor. The following input parameters are required: pressure, mass flux, hydraulic diameter, and quality. For the steady state case, critical heat flux (CHF), critical heat flux temperature, minimum film boiling temperature, and minimum film boiling heat flux are the primary outputs. With either the surface heat flux or wall temperature specified, the program determines the heat transfer regime and calculates the surface heat flux, wall temperature and heat transfer coefficient. For the slow transient case, pressure, mass flux, quality, and volumetric heat generation rate are the time dependent input parameters required to calculate the hot pin sheath temperatures and surface heat fluxes. A simple routine for generating properties has been developed for light water to support the above program. It contains correlations that have been verified for pressures ranging from 0.6kPa to 30 MPa, and temperatures up to 1100 degrees Celcius. The thermodynamic and transport properties that can be generated from this routine are: density, specific volume, enthalpy, specific heat capacity, conductivity, viscosity, surface tension and Prandtle number for saturated liquid, saturated vapour, subcooled liquid of superheated vapour. A software for predicting flow regime has also been developed. It determines the flow pattern at specific flow conditions, and provides a correction factor for calculating the CHF during partially stratified horizontal flow.

2105 Power Reactors, Breeding

Refer also to citation(s) 45079, 45147, 45148, 45152, 45158, 45159

45051 (INIS-BR–1576) **Simplified numerical simulation of hot channel in sodium cooled reactor.** Fonseca, F. de A.S. da; Silva Filho, E. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (In Portuguese). (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89636473/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The thermal-hydraulic parameter values that restrict the operation of a liquid sodium cooled reactor are not established by the average conditions of the coolant in the reactor core but by the extreme conditions of the hot channel. The present work was developed to analysis of hot channel of a sodium cooled reactor, adapting to this reactor an existent simplified model for hot channel of pressurized water reactor. The model was applied for a standard sodium reactor and the results are considered satisfatory. (author).

45052 (INIS-BR–1577) **Static pressure distribution in an angular channel with helicoidal wire.** Lemos, M.J.S. de. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89636474/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

This work reports data on pressure drop distribution along a channel formed by a wire-wrapped rod placed inside a circular tube. This geometry simulates the flow field in the vicinity of a tropical fuel rod of a LMFBR (Liquid-Metal Fast Breeder Reactor) fuel assembly. The working flyid was air and the range for the Reynolds number extended from 2.26×10^4 to 4.52×10^4. The aspect ratio, P/D and the lead-to-diameter ratio, 1/D, were 1.2 and 15, respectively. (author).

2106 Power Reactors, Auxiliary, Mobile, Package, and Transportable

Refer also to citation(s) 45397

2107 Regulation and Licensing

Refer also to citation(s) 45054, 45055, 45142, 46782

45053 (NUREG–0750-Vol.29-No.6) **Nuclear Regulatory Commission issuances.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Freedom of Information and Publications Services. Jun 1989. 101p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A06/MF A01 - GPO; OSTI; INIS.

This report includes the issuances received during the specified period from the Commission (CLI), the Atomic Safety and Licensing Appeal Boards (ALAB), the Atomic Safety and Licensing Boards (LBP), the Administrative Law Judge (ALJ), the Directors' Decisions (DD), and the Denials of Petitions for Rulemaking (DPRM).

2108 Economics

Refer also to citation(s) 45157

45054 (NUREG–1336-Rev.1) **Standard format and content guide for financial assurance mechanisms required for decommissioning under 10 CFR parts 30, 40, 70, and 72: Revision 1.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning. Aug 1989. 138p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A07/MF A01 - GPO; OSTI; INIS.

The Standard Format and Content Guide for Financial Assurance Mechanisms Required for Decommissioning under 10 CFR Parts 30, 40, 70, and 72, discusses the information to be provided in a license application and established a uniform format for presenting the information required to meet the decommissioning licensing requirements. The use of the Standard Format and Content Guide will (1) help ensure that the license application contains the information required by the regulations, (2) aid the applicant in ensuring that the information is complete, (3) help persons reading the Standard Format and Content Guide to locate information, and (4) contribute to shortening the time required for the review process. The Standard Format and Content Guide ensures that the information required to perform the review is provided, and in a useable format.

45055 (NUREG–1337-Rev.1) **Standard Review Plan for the review of financial assurance mechanisms for decommissioning under 10 CFR Parts 30, 40, 70, and 72: Revision 1.** Nuclear Regulatory Commission, Washington, DC (USA). Div. of Low-Level Waste Management and Decommissioning. Aug 1989. 44p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A03/MF A01 - GPO; OSTI; INIS.

Standard Review Plan (SRP) for the Review of Financial Assurance Mechanisms for Decommissioning under 10 CFR Parts 30, 40, 70 and 72, is prepared for the guidance of Nuclear Regulatory Commission staff reviewers in performing reviews of applications from material licensees affected by the decommissioning regulations established June 27, 1988 (53FR24018). The principal purpose of the SRP is to assure the quality and uniformity of staff reviews and to present a base from which to evaluate the financial assurance aspects of the applications. The SRP identifies who performs the review, the matters that are reviewed, the basis for the review, how the review is performed, and the conclusions that are sought.

45056 (ORNL/FTR–3347) **[OECD Expert Group meeting on reduction of capital costs of nuclear power plants, Paris, France, July 21–26, 1989]: Foreign trip report.** Hudson, C.R. II. Oak Ridge National Lab., TN (USA). 9 Aug 1989. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89015598/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The OECD initiated a study of means to reduce the capital costs of nuclear power plants in the latter part of 1988. To accomplish the study, an Expert Group consisting of representatives of OECD member countries was formed. The initial meeting of the Expert Group was held in November 1988. A second meeting, documented in an ORNL trip report by this author, was held in May 1989. This meeting represents the third follow-on meeting with the primary goal of reviewing the draft report written by members of the Expert Group.

45057 (SPRU-DRC-DP–40) **Steam power and nuclear power: the social savings of British energy technologies.** Tunzelmann, G.N. Von. Sussex Univ., Brighton (UK). Science Policy Research Unit. Oct 1986. 57p. Available from the British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ.

Comparisons are made between the shift from water to steam power in the Industrial Revolution and the shift from coal-fired electricity to nuclear power today. The methodological links between steam power and nuclear power are noted. Where energy supply is dominated by an old technology the advent of new power sources with lower medium-run marginal costs will lead to diffusion of the new source at the expense of the old. The balance lies in the economics of output against unit cost. The costs of nuclear and coal-fired plant to provide 1.2 GWe are compared, the main difference being in the capital cost (high for nuclear, lower for coal-fired) and fuel costs (low for nuclear, but high for coal and forecast prices). The forecast fuel prices are crucial to the economic analysis. These and other costs (safety, waste disposal etc.) are discussed in detail. (U.K.).

45058 Application of remote-control in-pipe inspection technology. Watanabe, H.; Ozawa, K. *Transactions of the American Nuclear Society (USA),* 57: 330-331 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

At nuclear power plants, there is a strong desire to maintain plant components soundly and to enhance the operation rate. Such a desire has increased the importance of the internal inspection of piping that accounts for a large percentage of plant components. To meet these needs, JGC Corporation in Japan has developed and practically applied various types of in-pipe traveling inspection robots applicable to piping that ranges in size from 4 to 24 in. in diameter. This paper introduces two robots that were developed recently: robot for 4- to 6-in. piping and a robot for 8- to 24-in. piping. Conventional in-pipe traveling inspection robots for small-diameter piping (6 in. and smaller) had difficulty passing inside 90-deg short elbows. The adoption of a spiral drive and special gears, however, has enabled passing inside of such elbows. Of conventional inspection robots for large-diameter piping, most of those which used a crawler drive to increase traction were apt to lose a certain amount of tractive force when they passed inside 90-deg short elbows. In the robot introduced herein, however, this problem was solved by developing a special crawler, which allowed slippage in the circumferential direction of the piping. At present, robots for small-diameter piping have been permanently installed and practically applied to the inspection of concentrator lines of radwaste facilities.

45059 Development of ultrasonic testing equipment using electromagnetic acoustic tranducers. Sato, M.; Kimura, M.; Nagase, K.; Ishikawa, M. *Transactions of the American Nuclear Society (USA),* 57: 333-334 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

In nuclear power stations, in-service inspection (ISI) is conducted during the periodic outage. During ISI, ultrasonic testing (UT) is conducted, which requires preparations such as removal of the pipe coating, surface polishing, and mounting UT equipment to enhance the reliability of UT. Because these tasks are performed in a radiation field, it is important to simplify them and reduce the inspection period. For this reason, a new type of automatic UT equipment has been developed. This equipment consists of a noncontacting ultrasonic transducer, the electromagnetic acoustic transducer (EMAT), and the vehicle that scans EMAT. This paper describes the equipment and a test result performed using the equipment. It was confirmed that EMAT can detect 1.0-mm-high notch and that locating accuracy could be kept within +2 mm by using the vehicle. Further efforts will be made to improve the signal-to-noise ratio.

22 NUCLEAR REACTOR TECHNOLOGY

2201 Theory and Calculation

Refer also to citation(s) 45848

45060 (CTA-EAV-NT–007/80) **Nuclear data catalogue.** Corcuera, R.P.; Tanaka, E. Centro Tecnico Aeroespacial, Sao Jose dos Campos, SP (Brazil). Inst. de Estudos Avancados. 5 Aug 1980. 294p. (In Portuguese). Order Number DE89636449/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS.

This catalog is a compilation of available nuclear data libraries. The data described here can be supplied to users on magnetic tapes, pushed cards, printed paper or plots. (author).

45061 (IAEA-TECDOC–491, pp. 7-11) **Nuclear data for the calculation of thermal reactor reactivity coefficients - A brief introduction.** Rowlands, J.L. (UKAEA Atomic Energy Establishment, Winfrith (UK)). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Several reactor physics groups have been unable to reproduce the measured values of thermal reactor reactivity coefficients using current evaluations of nuclear data. Consequently they have used modified data in the thermal energy region. In response to this problem differential cross section measurements have been made at Geel and Harwell. This paper briefly summarises the nuclear data changes made by these reactor physics groups and also summarises the assumptions made by some reactor physicists about the effect of crystalline structure on Doppler reactivity coefficients. (author). 9 refs.

45062 (IAEA-TECDOC–491, pp. 79-85) **Generalized subgroup approach to calculating resonance absorption of neutrons in nuclear reactors.** Tebin, V.V. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii). International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The author formulates a subgroup kinetic equation and describes a method of obtaining subgroup parameters assuming constant collision density within a given subgroup. (author). 14 refs, 1 fig., 1 tab.

45063 (IAEA-TECDOC–491, pp. 115-123) **Recent differential low energy cross-sections and thermal evaluations.** Deruytter, A.J. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements); Corvi, F.; Axton, E.J.; Schillebeeckx, P.; Wagemans, C. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Shapes of the fission cross-sections of ^{235}U, ^{239}Pu and ^{233}U were measured in the thermal and sub-thermal neutron energy regions, down to 2 meV, at the Geel linear electron accelerator, making use of a liquid nitrogen cooled methane moderator. For ^{235}U also a relative fission cross-section measurement was done at the Very Cold Neutron Source of the ILL at Grenoble. Preliminary results of these measurements are reported, and Westcott g_f factors based on these results are calculated. Also the shape of the $^{238}U(n,\gamma)$-reaction was measured at the Geel Linac in the same experimental conditions, and preliminary results are reported. Recent evaluations of the thermal parameters for ^{233}U, ^{235}U, ^{239}Pu and ^{241}Pu and the fission neutron yield of ^{252}Cf are briefly commented, and the difference between evaluation results with and without Maxwellian data discussed. (author). 15 refs, 9 figs, 5 tabs.

45064 (IAEA-TECDOC–491, pp. 123-125) **Preliminary results on eta of ^{235}U for sub-thermal neutron energies.** Wartena, J.A. (Commission of the European Communities, Geel (Belgium). Central Bureau for Nuclear Measurements); Weigmann, H.; Buerkholz, C. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

An experiment has been set up to measure the shape of eta, the relative number of fission neutrons emitted per neutron absorbed, for ^{235}U in the sub-thermal neutron energy range. A ^{235}U sample which is "black" for neutrons in the energy range of interest is exposed to a collimated neutron beam from the cooled moderator of the Geel electron linac, and a liquid scintillation detector with pulse shape discrimination is used for detection of the fission neutrons. The neutron flux is monitored with parallel plate proportional counters loaded with ^{6}Li or ^{10}B and ^{235}U. In separate runs the thick U sample is replaced by a thick ^{10}B slab used to measure the shape of the neutron flux. Preliminary results of the experiment are given. (author). 3 refs, 1 fig.

45065 (IAEA-TECDOC–491, pp. 126-131) **Doppler broadening effects in low energy resonances.** Moxon, M.C. (UKAEA Harwell Lab. (UK)); Sowerby, M.G. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The gas model of Doppler broadening is used both when resonance parameters are extracted from measurements of nuclear data and when these parameters are converted to the cross-sections needed for reactor calculations. A brief review is made of the available information on the adequacy of the gas model for low energy resonances ($\lesssim$ or $\sim$ 10 eV), as these are particularly significant for thermal reactors. It is found that the gas model with an effective temperature is not always an adequate prescription. (author). 19 refs, 6 figs, 3 tabs.

2202 Components and Accessories

Refer also to citation(s) 45112, 45161, 46553

45066 (CONF-8908125–2) **Flaw behavior in mechanically loaded clad plates.** Iskander, S.K.; Robinson, G.C.; Oland, C.B. Oak Ridge National Lab., TN (USA). 1989. 15p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From Post-SMIRT conference No. 2; 21-22 Aug 1989. Order Number DE89016261/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A small crack near the inner surface of clad nuclear reactor pressure vessels is an important consideration in the safety assessment of the structural integrity of the vessel. Four-point bend tests on large plate specimens, conforming to ASTM specification for pressure vessel plates, alloy steels, quenched and tempered, Mn-Mo and Mn-Mo-Ni (A533) grade B six clad and two unclad with stainless steels 308, 309 and 312 weld wires, were performed to determine the effect of cladding upon the propagation of small surface cracks subjected to stress states. Results indicated that the tough surface layer composed of cladding and/or heat-affected zone has enhanced the load-bearing capacity of plates under conditions where unclad plates have ruptured. The results are interpreted in terms of fracture mechanics. The behavior of flaws in clad reactor pressure vessels is examined in the light of the test results. 11 refs., 8 figs., 2 tabs.

45067 (CONF-8908125–3) **Effects of irradiation on the fracture properties of stainless steel weld overlay cladding.** Haggag, F.M.; Corwin, W.R.; Nanstad, R.K. Oak Ridge National Lab., TN (USA). 1989. 29p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From Post-SMIRT conference No. 2; 21-22 Aug 1989. Order Number DE89016265/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Stainless steel weld overlay cladding was fabricated using the submerged arc, single-wire, oscillating-electrode, and the three-wire, series-arc methods. Three layers of cladding were applied to a pressure vessel plate to provide adequate thickness for fabrication of test specimens, and irradiations were conducted at temperatures and to fluences relevant to power reactor operation. For the first single-wire method, the first layer was type 309, and the upper two layers were type 308 stainless steel. The type 309 was diluted considerably by excessive melting of the base plate. The three-wire method used various combinations of types 308, 309, and 304 stainless steel weld wires, and produced a highly controlled weld chemistry, microstructure, and fracture properties in all three layers of the weld. 14 refs., 15 figs., 4 tabs.

45068 (CONF-8909127–2) **Condition monitoring of machinery using motor current signature analysis.** Haynes, H.D.; Kryter, R.C. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From 1. international machinery monitoring and diagnostic conference; 11-14 Sep 1989. Order Number DE89012335/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Motor current signature analysis (MCSA) is a powerful monitoring tool for motor-driven equipment that provides a nonintrusive means for detecting changes in process conditions or the presence of mechanical abnormalities. It was recently developed at the Oak Ridge National Laboratory (ORNL) as a means for determining the effects of service wear on motor-operated valves used in nuclear power plant safety systems. MCSA is based on the recognition that an electric motor (ac or dc) driving a mechanical load acts as an efficient and permanently available transducer, sensing both large and small, long-term and rapid, mechanical load variation and converting them into variations in the induced current generated in the motor windings. The motor current signature, which is carried by the motor power cables, can be extracted at a convenient location and processed as needed to obtain time- and frequency-domain (spectral) characteristics which provide equipment condition indicators for trending over time. MCSA technology (patent applied for) has already been applied successfully to motor-operated valves, vacuum pumps, water pumps, air blowers and air conditioning systems, and examples of such application will be presented. The applicability of MCSA to a broader range of equipment monitoring and production line testing is also discussed. 1 ref., 8 figs.

45069 (EPRI-NP–5696) **Valve motor operator improvements: Final report.** Lee, R.A.S.; Kelly, J.S. Electric Power Research Inst., Palo Alto, CA (USA); Foster-Miller, Inc., Waltham, MA (USA). c Jul 1989. 277p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The performance of motor operated valves (MOVs) has been the subject of intense study over the past few years. Significant events resulting from MOV failures, including incapacitation of emergency and/or safe shutdown systems, have been reported frequently by numerous nuclear plant licensees. Evidence points to the fact that the documented failures are largely attributable to deficiencies in equipment design, application, operational and maintenance practices, and in the basic understanding of the equipment. The overall objectives of this project were to identify the specific root causes of selected events related to improper performance of valve motor operators; identify/develop means to correct the performance deficiencies; field test the identified/developed means for corrective action; and provide for the technology transfer of the developed corrective actions. The principal output of this research project was the development of the Intellitorque system, a microprocessor based control and diagnostics system intended for use on valve motor operators. The final report summarizes the Phase I effort, which included the laboratory development and testing of Intellitorque, and the Phase II effort, which has culminated in the installation and field demonstration of Intellitorque at two US nuclear power facilities. 17 refs., 93 figs., 19 tabs.

45070 (EPRI-NP–6316) **Guidelines for threaded-fastener application in nuclear power plants: Final report.** Looram, M.E.; Donovan, M.J.; Chung, Y.; White, R.A. Electric Power Research Inst., Palo Alto, CA (USA); Looram Engineering, Inc., East Haddam, CT (USA). c Jul 1989. 132p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The objective of this report is to provide guidance for selecting, specifying, procuring, inspecting and installing threaded fasteners. This information should be useful to plant personnel who find that they must choose replacement bolting, or establish a bolting standardization program. The report is organized into three sections: Selection, Specification, and Installation. 9 refs., 3 tabs.

45071 (NUREG/CR–4744-Vol.2-No.2) **Long-term embrittlement of cast duplex stainless steels in LWR systems: Semiannual report, April–September 1987.** Chopra, O.K.; Chung, H.M. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Argonne National Lab., IL (USA). Aug 1989. 49p. Sponsored by Nuclear Regulatory Commission. DOE Contract W-31109-ENG-38. (ANL–89/6-Vol.2-No.2). Available from NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

This progress report summarizes work performed by Argonne National Laboratory on long-term embrittlement of cast duplex stainless steels in LWR systems during the six months from April to September 1987. Microstructural studies were conducted to investigate the kinetics of spinodal decomposition and G-phase and γ_2 precipitation of CF-8 and CF-8M grades of cast stainless steel. The results indicate that the presence of Mo in CF-8M steel accelerates spinodal decomposition as well as G-phase and γ_2 precipitation. Examination of the long-term-aged CF-8M steels also revealed a "spinodal-like" decomposition of the austenite caused by segregation of Fe and Ni in the matrix. Preliminary results indicate that local regions of austenite are significantly hardened by the decomposition. Charpy-impact, tensile, and J-R curve data are presented for several heats of cast stainless steels aged at temperatures between 320 and 450°C for times up to 10,000 h. The results indicate that concentrations of carbon and nitrogen in the steel and the ferrite content and spacing are important parameters in controlling low-temperature embrittlement. The existing correlations for estimating the extent and kinetics of embrittlement do not accurately represent the properties of different grades and compositions of cast stainless steel after thermal aging. 36 refs., 24 figs., 5 tabs.

45072 (SAND–88-1849C) **US DOE emergency diesel performance prediction.** DeBey, T.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. (CONF-890911–1: International conference on operability of nuclear systems in normal and adverse environments, 18-22 Sep 1989). Order Number DE89010230/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy has been examining extension of the operational lives of commercial nuclear power plants through improved performance and continued operation beyond the initial design life term. One technique that seems promising for this task is the prediction of equipment performance through the use of innovative monitoring schemes. This technique is best applied to equipment that experiences failures that are not easily correlated with other commonly used indicators such as cumulative operating time or number of stress cycles. Such equipment often has testing and maintenance performed at periodic intervals. In response to this testing and maintenance, the performance of the equipment could be degraded. One such piece of equipment is the emergency diesel generator. 4 refs., 3 figs., 1 tab.

45073 (SAND–88-1882C) **Technical evaluation of in-containment cables for the US nuclear plant life extension.** DuCharme, A.R.; Bustard, L.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. (CONF-890911–2: International conference on operability of nuclear systems in normal and adverse environments, 18-22 Sep 1989). Order Number DE89011539/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Nuclear plants in the United States are licensed for 40 years even though safe operation for longer periods is possible. Currently there is substantial interest in extending the service life of these plants beyond their initial term. Cables have been identified by both industry and US NRC studies as components crucial to the safety and economic aspects of nuclear plant life extension. This paper describes a US DOE sponsored study to develop the technical basis for the life extension of in-containment cables. 6 refs., 1 fig., 1 tab.

45074 (SAND–88-2161C) **A critical look at nuclear qualified electrical cable insulation ignition and damage thresholds.** Nicolette, V.F.; Nowlen, S.P. Sandia National Labs., Albuquerque, NM (USA). 1989. 15p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890911–5: International conference on operability of nuclear systems in normal and adverse environments, 18-22 Sep 1989). Order Number DE89011534/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The modeling of fire growth and fire-induced damage to electrical equipment in nuclear power plants requires knowledge of the ignition and damage thresholds for nuclear qualified electrical cable insulation. The present state of knowledge regarding these thresholds is based on a very limited amount of experimental data. In this paper it is shown that some of the industry-accepted ignition and damage thresholds have been extrapolated well beyond the experimental data resulting in incorrect and nonconservative lower limits of electrical cable ignition and damage. A more appropriate parameter for determining cable damage thresholds is suggested. 16 refs., 7 figs.

45075 (SAND–88-2172C) **Condition monitoring and aging assessment for class 1E cables.** Jacobus, M.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 8p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890911–4: International conference on operability of nuclear systems in normal and adverse environments, 18-22 Sep 1989). Order Number DE89010770/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories is currently conducting long-term aging research on representative samples of US nuclear power plant Class 1E cables. The objectives of this program are to determine the suitability of these cables for extended life (beyond 40-year design basis) and to assess various cable condition monitoring (CM) techniques for predicting remaining cable life. 7 refs., 3 figs., 1 tab.

45076 (SAND–89-1099C) **Monitoring cables for local degradation.** Bustard, L.D.; Sliter, G.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by Electric Power Research Institute. DOE Contract AC04-76DP00789. (CONF-890911–7: International conference on operability of nuclear

systems in normal and adverse environments, 18-22 Sep 1989). Order Number DE89013582/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent experiences in operating nuclear plants in the United States have demonstrated the need for an in situ cable condition monitoring technique that can assess whether installed, low-voltage, unshielded cables have local damage that could compromise their ability to function under normal and accident service conditions. This paper summarizes current US programs that have been initiated to develop a technological basis for monitoring cables with local degradation. 7 refs.

2203 Fuel Elements

45077 (CONF-8909125–1) **High density fuel plates by hot isostatic pressing.** Wiencek, T.C.; Domagala, R.F.; Thresh, H.R. Argonne National Lab., IL (USA). Sep 1988. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From 11. international RERTR meeting; 19-22 Sep 1989. Order Number DE89012386/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The loading limits of dispersion fuel plates fabricated by currently conventional techniques have been reached for U_3Si and U_3Si_2. Fuel densities of up to 7.0 gU/cm have been successfully produced. While these loadings are sufficient for the needs of most research reactors, there are a few reactors that require higher fuel densities. Two concepts are presented which may achieve loadings beyond 7.0 gU/cm^3. First, a wire concept in which 0.030 in. (0. 76 mm) uranium silicide wire is bonded within an aluminum plate, and second a dispersion concept in which a highly loaded (>50 volume percent fuel), uniformly clad fuel plate is produced. Both concepts use hot isostatic pressing (HIP) as a key processing technique. 3 figs.

45078 (SAND–89-1086C) **Steam explosion studies with molten iron-alumina generated by thermite reactions.** Beck, D.F.; Berman, M.; Nelson, L.S. Sandia National Labs., Albuquerque, NM (USA). [1989]. 37p. Sponsored by DOD;DOE/DP. DOE Contract AC04-76DP00789. (CONF-890739–4: 12. international colloquium on the dynamics of explosions and reactive systems, 23-28 Jul 1989). Order Number DE89016033/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recent vapor explosion experiments at Sandia National Laboratories have used water and melts prepared by thermite reactions (~3000 K), with specific interest in the effects of initial (pre-explosion) melt-water mixture properties and of trigger strength on the energetics of the reaction. Mixture behavior studies used a nominal 2 kg of melt that was dispersed into the water to form a "coarse" mixture by one of two ways: the first method employed a crucible that was submerged under the water and used a gas-driven piston and orifice combination to control melt ejection and thus mixture properties; the second technique simply reacted a compressed thermite billet in situ (underwater) and relied on the expansion of heated gas trapped within the billet to disperse the melt. Triggers (generated by firing a submerged detonator near the mixture) were applied at selected times that reflected different degrees of melt dispersion. Trigger strength effects have been investigated by use of a single drop of melt (~5 g) and various underwater pressure sources. Visually, the response of the melt drop to a trigger is a rapid radial expansion of fine particles. Quantitatively, the degree and rate of explosive expansion has been related to the trigger strength. Final-to-initial volume ratios of over 100 have been observed for the strongest triggers, with growth periods on the order of 5 ms. Scaling laws common to conventional underwater explosions have been applied to the experimental data and give impulses that are the same order of magnitude as generated by hydrodynamic code calculations. 54 refs., 12 figs., 3 tabs.

2204 Control Systems

Refer also to citation(s) 45115

45079 (CONF-8909130–1) **Use of a pattern recognition scheme to compensate for critical sensor failures.** Singer, R.M.; King, R.W.; Mott, J. Argonne National Lab., Idaho Falls, ID (USA). 1989. 6p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. From First international machinery monitoring and diagnostic conference; 11-14 Sep 1989. Order Number DE89012430/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A general mathematical approach (the SSA code) for embodying learned data from a complex system and combining it with a current observation to estimate the true current state of the system has been applied to a nuclear power plant (EBR-II). Sensor validation and generation of estimates signals based upon the plant operating state are used for replacement of signals from multiple faulted sensors on a near real-time basis. A direct experimental demonstration of the capability of the code to perform these tasks is presented in which multiple sensor faults in EBR-II are simulated. 2 refs., 4 figs.

45080 (DOE/NE/37959–33) **Multi-dimensional process hypercube for signal validation.** Holbert, K.E.; Upadhyaya, B.R. Tennessee Univ., Knoxville, TN (USA). Dept. of Nuclear Engineering. Jul 1989. 61p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-86NE37959. Order Number DE89016239/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The optimal control and safe operation of a nuclear power plant requires reliable information concerning the state of the process. Signal validation is the detection, isolation and characterization of faulty signals. Properly validated process signals are beneficial from the standpoint of increased plant availability and reliability of operator actions. A signal validation technique utilizing a process hypercube comparison (PHC) was developed during this research. The hypercube is a multi-dimensional joint histogram of the process conditions. The hypercube is created off-line during a learning phase. In the event that a newly observed plant state does not match with those in the learned hypercube, the PHC algorithm performs signal validation by progressively hypothesizing that one or more signals is in error. This assumption is then either substantiated or denied. In the case where many signals are found to be in error, a conclusion that the process conditions are abnormal is reached. The hypercube signal validation methodology was tested using operational data from both a commercial pressurized water reactor (PWR) and the Experimental Breeder Reactor II (EBR-II). 11 refs., 26 figs., 3 tabs.

45081 (DP-MS–89-79) **Initiation—A neophyte's introduction to QA.** Johnston, B.S. Westinghouse Savannah River Co., Aiken, SC (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC09-89SR18035. (CONF-8909110–2: 16. annual conference of the American Society for Quality Control, 17-20 Sep 1989). Order Number DE89013553/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Nuclear Reactor Technology and Scientific Computations Program of the Savannah River Laboratory recently instituted a set of quality assurance procedures consistent with NQA-1 standards for the commercial nuclear industry. The author, not without trepidation, applied these new procedures to his experimental studies in two-phase flow. He made some mistakes, but had a goodly share of beginner's luck, as well. This paper presents a personal view of QA, describing the lessons learned in applying QA procedures to experimental research. 7 refs.

45082 (NUREG/CR–5290) **Closeout of IE Bulletin 79-28: Possible malfunction of NAMCO Model EA180 limit switches at elevated temperatures.** Foley, W.J.; Dean, R.S.; Hennick, A. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Operational Events Assessment; Parameter, Inc., Elm Grove, WI (USA). Aug 1989. 22p. Sponsored by Nuclear Regulatory Commission. (PARAMETER/IE–181). Available from NTIS, PC A03/MF A01 - GPO - OSTI.

Documentation is provided in this report for the closeout of IE Bulletin 79-28 regarding the possible malfunction of NAMCO Model EA180 limit switched in safety-related systems at elevated temperatures. Closeout is based on the implementation and verification of four (4) required actions by holders of operating licenses or construction permits for nuclear power facilities. Evaluation of utility responses and NRC/Region inspection reports indicated that the bulletin is closed for all of the 119 facilities to which it was issued for action. It is concluded from the results that although the potential problem was widespread, supporting documentation shows that the bulletin concern has been resolved.

2205 Environmental Aspects

Refer also to citation(s) 44723, 44739, 44740, 44741, 44742, 44743, 44744, 45137, 45150, 46144, 46299, 46759

45083 (GEND-INF–090) **TMI-2 B-loop steam generator tube sheet loose debris examination and analysis.** Hayner, G.O.; Hardt, T.L. Babcock and Wilcox Co., Lynchburg, VA (USA). Contract Research Div. Jun 1989. 181p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016172/JAW. Available from NTIS, PC A09/MF A01 - OSTI.

The debris recovered from the upper tube sheet of the TMI-2-B-loop steam generator was analyzed in an effort to determine the concentration and distribution of the chemical and radiochemical species. The debris is of special interest because it is believed to have been transported from the core region sequence between 174 and 192 min after accident initiation when a B-loop reactor coolant pump was restarted. Characterization of five size fractions and 10 of the largest particles was accomplished by destructive (chemical, radiochemical, metallography, and SEM/EDS) and nondestructive (photographic examination and density) methods of analysis. 2 refs., 7 figs., 14 tabs.

45084 (INFO–0210(E)(Rev.1)) **Radioactive release data from Canadian nuclear generating stations 1972 to 1986.** Atomic Energy Control Board, Ottawa, ON (Canada). Sep 1987. 25p. Order Number DE89635543/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Derived Release Limits (DRLs) are established for controlling releases of radioactive materials from licensed nuclear generating stations during routine operations. DRLs are calculated rate values for releases which, if reached, would, according to a calculational model, result in the maximum permitted radiation dose to a member of the public living at the boundary of the facility, considering all environmental pathways of exposure. The dose limits set out in the Atomic Energy Control Regulations for members of the public are given. The first edition of this report was published in September 1986, covering the period 1972 to 1985. Several comments and suggestions for improvement were received and taken into account when preparing this edition.

45085 (NUREG/CP–0098-Vol.1, pp. 21-98) **Review of containment vent filter technology.** Kovach, J.L. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

The technology applied for the design and construction of containment vent filters is compiled and reviewed. The national positions leading to the selection of venting or method of filtration are extracted from position papers. Several areas of further information needs are identified.

45086 (NUREG/CP–0098-Vol.1, pp. 248-258) **Measurement and removal of steel flame cutting aerosols (0.01-1 μm) in WAGR decommissioning.** Robinson, K.S.; Hamblin, C. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

This paper gives details of work undertaken in support of the AGR decommissioning program at Windscale Nuclear Laboratories using full-scale inactive simulation of oxy/propane flame cutting operations. Cutting fume aerosol size distributions and concentrations were measured and tests were undertaken to establish the performance of an electrostatic precipitator and reverse pulse cleaned cartridge filter as prefilters for the main ventilation HEPA filters.

45087 (NUREG/CP–0098-Vol.1, pp. 259-277) **Development of a multi-tube axial flow cyclone separator system for use in nuclear gas cleaning systems.** Stallard, P. (Pall Europe Limited, Portsmouth (England)); Scowen, P.; Oates, P.W.; Meddings, P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

Axial flow cyclone separators have been used typically to protect gas turbine and Diesel engines and control systems from abrasive airborne contaminants. The axial flow cyclone system provides a permanent, high efficiency, non-clogging separator with no moving parts and minimum maintenance requirements. In this paper the development, testing and application of separator panels using multiple 2-stage separators are described. Several nuclear application concepts are discussed, and details are given of a specific installation at Dungeness B nuclear power station. The design objectives for the separator system were: (a) to develop the dust separation efficiency to a level above that of existing units and (b) to minimize dust hold-up within the separator assembly so as to minimize the exposure of maintenance personnel to radioactive debris. The multi-tube separator assembly achieved an efficiency of separation of 98.5% and a dust hold-up of 162 g when tested with AC coarse test dust.

45088 (NUREG/CP–0098-Vol.1, pp. 457-468) **Analytic approach to noble gas migration.** Adams, W.J. (Sargent & Lundy, Chicago, IL (USA)); Bhasin, D.P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

The purpose of this paper is to discuss an analytic approach used to model noble gas migration in the auxiliary building of a nuclear power plant. This approach uses a detailed computer model of the auxiliary building that has been benchmarked against test data to identify and predict unintended gas migrations in the plant. The end result is an analytical tool that is capable of investigating the effects of potential plant changes made to prevent gas migration. Because of the many discrete potential gas source locations and the large number of gas migration routes, a detailed model is required. A separate node in the model is used to represent each source location subcompartment. Also included in the model are ducted HVAC supply and exhaust flows for each node and non-ducted flow paths allowing gas migration between areas in the plant. This paper discusses the data required for this approach. Various plant drawings and a plant walkdown were required in order to develop an accurate model of the plant. Subcompartment pressure measurements, ducted flow rates, and tracer test results were required to provide baseline data and benchmarking of the analytical model. As a result of the computer analysis, specific areas of the plant susceptible to gas migration were identified. The mechanisms allowing this migration were examined and the effectiveness of potential plant changes to mitigate gas migration were investigated using the computer model.

45089 (NUREG/CP–0098-Vol.1, pp. 537-559) **Trapping performance of 1.5% KI 207B charcoal for methyl iodine in CO_2 at high temperature and pressure.** Collinson, B. (United Kingdom Atomic Energy Authority, Seascale, Cumbria); Taylor, L.R.; Meddings, P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

Recent experimental work is reported on the trapping performance of current UK potassium iodide impregnated coal based charcoal for methyl iodide in CO_2 at pressures up to 42 bar (4.2 MPa) and temperatures up to 275°C. The aim of the work is to underwrite the performance of the iodine adsorption plants in the blowdown systems of the UK Commercial Advanced Gas-cooled Reactors (CAGRs). The current results, which are consistent with earlier

data, show that an increase in pressure at constant gas staytime leads to a reduction in trapping performance and that above about 200°C the performance is further reduced as a result of increased desorption of iodine species. Tests carried out with I-131 labelled KI impregnant indicate that flowing gas can remove iodine from the impregnant, the rate of loss increasing exponentially with temperature and linearly with flowrate. After passing CO_2 gas through a charcoal bed at 244°C for 30 days some 40% of the impregnant was found to have been removed from the charcoal. The effect of variations in methyl iodide loading and gas face velocity have also been investigated. The trapping performance can be characterized by a K value defined by $DF = 10^{K.t}$, where DF is the Decontamination Factor and t the staytime of the gas within the charcoal bed. A significant reduction in K value was observed at high methyl iodide loadings greater than 200 μg CH_3I/g charcoal. The K value was also found to vary as $(\text{gas velocity})^{0.6}$, this result suggests that the trapping performance is mainly controlled by mass transfer from the flowing gas to the surface of the charcoal granules.

45090 (NUREG/CP–0098-Vol.1, pp. 560-571) **Effect of organic material on carbon aging.** Hyder, M.L. (E.I. du Pont de Nemours and Co., Aiken, SC (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

Activated carbon is used in the confinement systems for the Savannah River Plant reactors to retain elemental or organic radioiodine in the reactor building effluent air. Studies were undertaken to determine the practical importance of organic accumulation as compared to other aging mechanisms. In addition, the effect of organic accumulations on the radiolytic release of iodine was investigated. Three types of investigation were conducted. In the first, the amount of organic material accumulated on carbon during service was measured in a large number of carbon samples from the reactor confinement system, using liquid extraction and quantitative gas chromatography. The resulting data were correlated with methyl iodide retention measurements and statistically examined to determine the importance of the organic content to the aging process. In a few samples additional organic material (xylene) was added to the organics already present, and the methyl iodide retention was measured before and after this addition, to determine the differential effect of the added material. The second set of experiments dealt with bromotrifluoromethane (Halon®), a fire extinguishing agent used in large quantities in automatic protective equipment in the reactor building. Its possible persistence on the carbon following a release was of concern because of the quantities involved. The loading and release of this compound from new and used carbons was measured experimentally. Finally, the effect of organics on the release of iodine from carbon in a radiation field was investigated. The release of organic iodine from a variety of carbon samples was measured before and after the addition of iodine to the carbon. The experiments included studies in which this was measured before and after adding organic material to the samples.

45091 (NUREG/CP–0098-Vol.1, pp. 589-601) **Chemical analysis of new and used 5% TEDA - impregnated carbon.** Guest, A.; Holtorp, J.; Massey, R. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

All radioiodine filters in Ontario Hydro's nuclear generating stations use 5% triethylene diamine impregnated carbon as an absorbent. Because replacement carbon, management of used carbon from the filters, and labor to change the carbon are expensive, increased service-life is desirable. Methods to optimize the quality of the new carbon, including analysis methods for new supplies, are described. Analysis of carbon samples taken from filters, to try to determine the reason for deterioration in service, are also discussed.

45092 (NUREG/CP–0098-Vol.2, pp. 630-649) **Experimental measurements of dropsize distribution in an array of water sprays.** Hightower, N.T. III (E.I. du Pont de Nemours and Company, Aiken, SC (USA)); Bassett, T.A. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Experimental measurements of the spatial dropsize distribution (DSD) for a proposed improved reactor spray system (IRSS) array for the Savannah River production reactors were conducted to characterize the spatial DSD at various vertical distances below the tip of the spray nozzles. The grid spacing between the nozzles was varied for the array to investigate the effect of spacing on DSD. Since buffered water is known to enhance the scrubbing effectiveness of sprays, unbuffered water and buffered water were used to investigate the effect on DSD. DSD data for the proposed IRSS were necessary to evaluate the effectiveness of gas cooling and radioactive halogen and particulate scrubbing in the reactor room air following a hypothetical severe core-melt accident. The test data will be used in the computer simulation design process of the proposed IRSS for the Savannah River production reactors. The tests represent one of the first full-scale measurements of spatial DSD for a representative section of a spray system array in the United States. No known reactor safety calculations involving the application of sprays in containment or confinement systems account for the variation of DSD with distance. These tests were an attempt to investigate this phenomenon. The tests are significant due to the widespread application of sprays in the containment or confinement system of nuclear reactors.

45093 (NUREG/CP–0098-Vol.2, pp. 650-667) **Experimental measurements of air cleaning with water sprays.** Hyder, M.L. (E.I. du Pont de Nemours and Co., Aiken, SC (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The effectiveness of water sprays for removal of gaseous and particulate fission products from air was studied experimentally, to determine the value of existing and proposed spray systems at the Savannah River reactors for cleaning the reactor room air following a hypothetical severe accident. The interaction of spray droplets with iodine and with cesium aerosols formed by combustion were measured separately. In the case of iodine, the results were compared to the theoretical treatment of Albert, Wichner, and Baumgarten. Good agreement was found for the smaller drop sizes, and the effect of spray pH predicted by the theoretical model was confirmed. The aerosol studies demonstrated the effectiveness of sprays in removing aerosol particles larger than 1 micrometer.

45094 (NUREG/CP–0098-Vol.2, pp. 749-768) **Theoretical and experimental investigation on adaptability of charcoal beds to containment filter venting in Italian nuclear power plant.** Caropreso, G. (E.N.E.A. - Comitato Nazionale per la Ricerca e per lo Sviluppo dell'Energia Nucleare e delle Energie Alternative, Rome (Italy)); Leonardi, A.; Perna, W.; Sgalambro, G. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The work has been divided into three parts. The first one gives a description of the facilities under investigation during some selected accidental conditions, also described. The second part, which consists of an experimental work, tries to identify the behavior of charcoal beds in terms of pressure drop vs the aerosol mass

loading and of aerosol retention efficiency. On the basis of the experimental findings, the prediction of the behavior of the real beds is carried out in the third part, as regards the pressure drop through the beds, related to the selected accident scenarios. In addition in this last part the results of a preliminary evaluation of the maximum decay power picked up by the beds without reaching the carbon self-ignition temperature have been reported.

45095 (NUREG/CP–0098-Vol.2, pp. 769-785) **Radioactive noble gas adsorption and irradiation studies.** Monson, P.R. Jr. (E.I. du Pont de Nemours & Co., Aiken, SC (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

In the event of a fuel melting accident at a nuclear reactor a significant inventory of radioactive material could be released into the reactor room or containment vessel. This radioactive material would consist of particulate matter, iodine, tritium and the noble gases (krypton and xenon). In the case of reactors with containment domes, these gases would be contained for subsequent clean-up or treatment through a vented containment system. For reactors without containment domes the particulate matter and iodine can be effectively removed through conventional filtration; however, the noble gases would escape to the environment. In either case, it would be highly desirable to have a system that could be brought online to effectively remove the noble gases thereby minimizing the risk to offsite population. Savannah River Laboratory has been working on development of a Low Temperature Adsorption System (LTAS) for treating radioactive noble gases released from a hypothetical reactor accident. This paper will discuss recent result that indicate enhanced adsorption of radioactive xenon on silver mordenite and carbon versus non-radioactive xenon adsorption. Enhancement factors of up to 20 times were observed in tests carried out using the radioactive noble gases in the helium blanket gas of an operating reactor. Results of follow-up tests on the adsorption of non-radioactive noble gases under cobalt irradiation will also be given.

45096 (NUREG/CP–0098-Vol.2, pp. 786-801) **Study of the performance of charcoal filters under post-LOCA conditions.** Wren, J.C. (Whiteshell Nuclear Research Establishment, Pinawa, Manitoba (Canada)); Moore, C.J.; Vikis, A.C.; Fluke, R.J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

A comprehensive study of the performance of TEDA- and KI-impregnated charcoals has been done under reactor accident conditions. The efficiency of these charcoals in removing CH_3I and I_2 was studied as a function of temperature, relative humidity, radiation field with and without H_2, contaminants and other factors. In addition to determining the decontamination factor, in certain cases, the distribution of activity along the length of the charcoal bed was monitored as a function of purging time. Activity distribution measurements were useful in understanding the chemistry of these systems.

45097 (NUREG/CP–0098-Vol.2, pp. 824-833) **Chemistry and behavior of iodine-vapor species in nuclear plant air-monitoring sampling lines.** Wright, A.L. (Oak Ridge National Laboratory, TN (USA)); Fish, B.R.; Beahm, E.C.; Weber, C.F. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Investigations related to characterization of iodine species vapor deposition in air-monitoring sampling lines are being performed by the Tennessee Valley Authority. These investigations involve determination of iodine chemical species airborne in containment under severe-accident conditions and the development of models to predict vapor deposition in sampling lines.

45098 (NUREG/CP–0098-Vol.2, pp. 1003-1015) **In-situ testing of carbon filters at Ontario Hydro's nuclear generating stations.** Guest, A. (Ontario Hydro (Canada)); Holtorp, J. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The current test procedure to determine the need for change-out of carbon in Ontario Hydro's nuclear station filters is the ASTM D3803 radioiodine retention test. There are concerns over this laboratory test procedure and even greater concern over the representativeness of the sample. Consequently in-situ test procedures, using freon-11 and methyl iodide as challenge gases, are being developed. The methods used are described and results are compared to the D3803 test results.

45099 (NUREG/CP–0098-Vol.2, pp. 1025-1038) **In-place leak test of carbon filters using a pulse injection method.** Dajlevic, D. (Institut de Protection et de Surete Nucleaire, Gif-Sur-Yvette (France)); Le Breton, M.; Maurel, J.M.; Mulcey, Ph. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The limits of in place testing of iodine filters with $^{131}ICH_3$ led to develop a complementary method aiming at delivering specific information about packing and mounting quality of such filters. The choice was made of a pulse injection method using Freon 12 (CCl_2F_2) and either an electron capture or a flame ionization detector. This method was qualified on the STRATUS test rig at Saclay and was successfully applied to various situations such as: acceptance tests in PWR's, assistance to manufacturers and expertise of a poorly efficient iodine filter train.

45100 (NUREG/CP–0098-Vol.2, pp. 1039-1054) **Belgian experience in operation and testing of gasketless charcoal adsorbers.** Vandewalle, A. (Vincotte, Brussels (Belgium)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Since the 80's, almost all filtration systems installed in the new Belgian Nuclear Power plants have been equipped with gasketless charcoal adsorbers. Depending on the architect engineers and applications, different options were chosen, using e.g. several bed depth, with or without guard beds, with or without pneumatic loading systems. This paper presents a synthesis of more than 1000 adsorber system-years of experience obtained from the periodic testing of this particular type of filters. The testing method used in Belgium (injection of I-131 tracer in the form of either methyliodide or molecular iodine) allows to gather valuable informations about the behavior of those gasketless adsorbers in actual working conditions. In addition to the particular testing method, an extrapolation technique is used to be able to determine an expected decontamination factor in design operating conditions (higher relative humidities - higher air flow rates). Finally, several testing, design and working problems encountered with those type of adsorbers are discussed.

45101 (NUREG/CP–0098-Vol.2, pp. 1117-1129) **Long-term desorption of CH_3I from a TEDA-impregnated charcoal bed under post-LOCA conditions.** Wren, J.C. (Whiteshell Nuclear Research Establishment, Manitoba (Canada)); Moore, C.J. Nuclear

Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The long-term desorption of radioiodines from charcoal filters is important in determining the radiological consequences of nuclear reactor accidents. For this reason, we have measured the migration of CH_3I along a TEDA-impregnated charcoal bed during purging, and we have determined the CH_3I release from the bed as a function of purging time. We have also developed a kinetic model, based on gas chromatography theory, to account for the CH_3I migration along the bed. Experiments were carried out using a TEDA-charcoal bed, 20 cm deep and 5 cm in diameter, at 80°C and 68% relative humidity. The CH_3I distribution along the length of the charcoal bed was exponential immediately after loading 0.32 g of CH_3I. On purging, the initial narrow distribution broadened and developed into a band, which continued to broaden and move downstream with time. The movement of CH_3I, however, was very slow, and the total ^{131}I activity released during 23 d purging was negligible. To model the CH_3I migration with purging time, we have modified the elution equation of gas chromatography (GC). The elution equation used in conventional GC analyses is appropriate only when the eluent is injected in the form of a delta function; it does not accommodate an initially exponential distribution, which we observed in our experiment. The model was successful in reproducing the observed distributions as functions of time.

45102 (NUREG/CP–0098-Vol.2, pp. 1242-1267) **Proposed new approach to allow improvement of nuclear air treatment systems for power plants.** Jacox, J.W. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Historically Nuclear Air Treatment Systems (NATS) have had a low priority as nuclear power plant systems. This low priority includes the full spectrum of system life from initial specification and space allocation through design, fabrication, installations, start-up, operation, testing and maintenance. In some plants, the only NATS that are properly maintained are those that are required in the Plant License Technical Specifications (PTs). There are undoubtedly a number of reasons for this situation. The fact that there is no complete and accurate data on the total cost of these systems is suggested as a major contributor to these continuing problems. When it is impossible for a system engineer to obtain the cost data to present to management as a part of the package for proposed system maintenance, modifications or improvements these requests have little chance of approval. Worse, the major cost overruns that regularly occur due to poor specification, design, fabrication, installation and maintenance are not assignable to the specific NATS so the normal industry driving force of detailed cost analysis can not operate. This is certainly a major reason that we have all seen the same problems repeated over the life of the civilian nuclear power industry. This paper will define the scope of the problem of lace of accurate cost data, offer examples of it's severity and a proposed solution.

45103 (NUREG/CR–5155) **The thermal instability of cesium iodide.** Elrick, R.M.; Merrill, R.M.; Ouellette, A.L. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Systems Research; Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 98p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (SAND–88-1187). Available from NTIS, PC A06/MF A01 - GPO - OSTI.

Recent data indicate cesium iodide can react with stainless steel in a high temperature steam and hydrogen environment. A quantitative model proposed for this reaction suggests that the decomposition of CsI depends strongly on the surface area of steel, the reaction time and the concentrations of CsI vapor and hydrogen. A two-level factorial matrix of ten experiments was designed to explore the statistical significance of the effect of these four variables on the instability of CsI. Each test was divided into time-quarters that simulated particular aspects of a degraded core accident. Steel oxidation during the first quarter conditioned the system for CsI interaction with oxidized surfaces during the second quarter, similar to the initial release of radionuclides. Here, CsI behavior was consistent with predictions of the physical model. In the third quarter additional hydrogen was added – corresponding to zircaloy oxidation, then cut off during the fourth quarter – similar to cessation of zircaloy oxidation. Instability behavior during the third and fourth quarters, dissimilar to model predictions, was attributed to a fundamental change in the surface oxide, which was reduced during the addition of hydrogen and reoxidized in the fourth quarter. Empirical model equations are presented for CsI behavior during the three quarters. 7 refs., 29 figs., 18 tabs.

45104 (PB–89-190235/XAB) **Analysis of fish-diversion efficiency and survivorship in the fish-return system at San Onofre Nuclear Generating Station. Technical report.** Love, M.S.; Sandhu, M.; Stein, J.; Herbinson, K.T.; Moore, R.H. National Marine Fisheries Service, Seattle, WA (USA). Apr 1989. 24p. (NOAA-TR-NMFS–76). Available from NTIS, PC A03/MF A01.

The study examined the efficiency of fish diversion and survivorship of diverted fishes in the San Onofre Nuclear Generating Station Fish Return System in 1984 and 1985. Fishes were diverted back to the ocean with high frequency, particularly in 1984. Most species were diverted at rates of 80% or more. Over 90% of the most abundant species, Engraulis mordax, were diverted. The system worked particularly well for strong-swimming forms such as Paralabrax clathratus, Atherinopsis californiensis, and Xenistitus californiensis, and did not appreciably divert weaker-swimming species such as Porichthys notatus, Heterostichus rostatus, and Syngnathus sp. Return rates of some species were not as high in 1985 as in 1984. Individuals of most tested species survived both transit through the fish return system and 96 hours in a holding net. Some species, such as E. mordax, X. californiensis, and Umbrina rancador, experienced little or no mortality. Survivorship of Seriphus politus was highly variable and no Anchoa delicatissima survived.

45105 (WHC-SP–0233) **N Reactor filter system fission-product retention assessment.** Muhlstein, L.D.; Jeppson, D.W.; McCormack, J.D. Westinghouse Hanford Co., Richland, WA (USA). Jun 1988. 40p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015991/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Data for the N Reactor High-Efficiency Particulate Air (HEPA) filter and charcoal filter systems have been evaluated to determine appropriate filter efficiencies for elemental iodine, methyl iodide, hydrogen iodide, and particulates. The data supports the following filter efficiencies: particulates - 99.95%, elemental iodine - 99%, methyl iodide - 70%, and hydrogen iodide - 99%. The HEPA filter and charcoal filter system, loading capacities have been determined for both radionuclide and non-radioactive aerosols. The results demonstrated that the capacity of the N Reactor confinement filtration system is more than adequate to retain both radionuclide and non-radioactive aerosols postulated to be released during accident situations without overloading. In addition, potential filter failure due to unacceptable heat loads from collected radionuclides was evaluated. The results show that with an acceptable air flow through the filter system (greater than 850 ft^3/min), the heat load on the filters from deposited radionuclides will not lead to filter failure. 30 refs., 8 figs., 13 tabs.

2206 Research, Test, and Experimental Reactors

Refer also to citation(s) 44817, 45114, 45141

45106 (TUBIK–62) **Neutronic analysis of HEU to LEU conversion calculation for AEOI 5 MW pool-type MTR fuel research reactor core.** Pazirandeh, A.; Lutz, D.; Bartsch, G. Technische Univ. Berlin (Germany, F.R.). Inst. fuer Kerntechnik. Jul 1987. 49p. Order Number DE89914956/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The possibility of converting HEU(93%) fuel to LEU(20%) fuel without or with slight alteration to the fuel element geometry is discussed. The fuel density varies between 1.7 to 4.1 g U-235/cm. In cross section generation a unit cell with an extra zone to account for extra Al and water was considered. In burnup calculations a sequential shuffling pattern was assumed with fixed position control fuel elements. A cross section data set in 45 energy groups were generated using RSYST/CGM system using the cross section library JFET. Then for 2D-diffusion calculations homogenized and condensed 5 energy group cross sections were prepared. (orig./HP).

45107 Research opportunities and planned facilities at the advanced neutron source. Rush, J.J. *Transactions of the American Nuclear Society (USA),* 55: 290 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

The concept design of the advanced neutron source (ANS) and the projected neutron fluxes available for research applications will make this advanced research reactor the premier neutron research facility in the world. The large accessible volume with fluxes within 80% of peak thermal flux, along with improved beam tube geometry will provide an order of magnitude increase in capability over any existing reactor for thermal and cold neutron research on materials. In addition, irradiation facilities are planned that will match or exceed current production of transuranium and other isotopes at the high-flux isotope reactor. The design team is also actively seeking to integrate special capabilities in modern trace analysis methods and radiation damage studies into the ANS. The national steering committee for the ANS, along with scientific and engineering staff at Oak Ridge National Laboratory, has laid out a preliminary configuration of some 40 neutron scattering stations, more than half of these being located in a large cold neutron guide hall with a state-of-the art guide tube assembly. When these are combined with planned facilities and locations for fundamental physics research, isotope production, and sample irradiations, the total complement of experimental facilities is potentially in excess of 70. This will provide unparalleled diversity and flexibility in neutron research and technology applications.

45108 Accuracy of transport calculations for the advanced neutron source. Azmy, Y.Y. (Oak Ridge National Lab., TN (USA)). *Transactions of the American Nuclear Society (USA),* 55: 293-294 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

The advanced neutron source (ANS) is a new research facility, based on a steady-state reactor neutron source, that is designed to produce an unprecedented thermal flux peak level of ≈ 5 to 10×10^{19} n/m^2 · s. This is achieved by the simultaneous reduction of the core volume and of the moderation within the core. Hence, all the candidate designs for the ANS reactor are characterized by their very compact core geometry, high fuel enrichments, and low D_2O moderator/coolant content within the core. It follows that the thermal flux gradient in the core, as well as the epithermal and fast flux gradients in the core, as well as the epithermal and fast flux gradients in the large D_2O pool reflector, are extremely large. This raises questions about the adequacy of diffusion calculations for this problem, and also about the accuracy of the DORT transport calculations performed to verify the diffusion calculations; in this paper the latter question is considered. In the most rigorous sense, the accuracy must be determined on a pointwise basis for all calculated quantities, i.e., the group angular flux. Practically, however, only a few integral quantities, whose accuracy is crucial for the proper design and operation of the ANS, can be identified, e.g., the effective multiplication factor, the fission source, the heating rate of the pressure vessel, etc. For an early design model of the ANS these quantities are calculated by DORT to a high degree of accuracy because the large group flux gradients occur at locations where the corresponding group flux level is extremely low.

2207 Plutonium and Isotope Production Reactors

Refer also to citation(s) 45105, 45155

2209 Reactor Safety

Refer also to citation(s) 44811, 44813, 45021, 45026, 45044, 45069, 45072, 45083, 45094, 45095, 45096, 45097, 45105, 45988, 46115, 46290, 46291, 46572

45109 (AECL–8762) **AMPTRACT: an algebraic model for computing pressure tube circumferential and steam temperature transients under stratified channel coolant conditions.** Gulshani, P.; So, C.B. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. Oct 1986. 27p. (CONF-861035–: 2. international meeting on simulation methods in nuclear engineering, 14-16 Oct 1986). Order Number DE89635530/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In a number of postulated accident scenarios in a CANDU reactor, some of the horizontal fuel channels are predicted to experience periods of stratified channel coolant condition which can lead to a circumferential temperature gradient around the pressure tube. To study pressure tube strain and integrity under stratified flow channel conditions, it is, necessary to determine the pressure tube circumferential temperature distribution. This paper presents an algebraic model, called AMPTRACT (Algebraic Model for Pressure Tube TRAnsient Circumferential Temperature), developed to give the transient temperature distribution in a closed form. AMPTRACT models the following modes of heat transfer: radiation from the outermost elements to the pressure tube and from the pressure to calandria tube, convection between the fuel elements and the pressure tube and superheated steam, and circumferential conduction from the exposed to submerged part of the pressure tube. An iterative procedure is used to solve the mass and energy equations in closed form for axial steam and fuel-sheath transient temperature distributions. The one-dimensional conduction equation is then solved to obtain the pressure tube circumferential transient temperature distribution in a cosine series expansion. In the limit of large times and in the absence of convection and radiation to the calandria tube, the predicted pressure tube temperature distribution reduces identically to a parabolic profile. In this limit, however, radiation cannot be ignored because the temperatures are generally high. Convection and radiation tend to flatten the parabolic distribution.

45110 (AECL–9093) **Burning rates of hydrogen-air mixtures in containment buildings and the consequent pressure transients.** Tennankore, K.N.; Kumar, R.K.; Razzaghi, M. Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment. 1987. 30p. Order Number DE89635465/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

One-dimensional flame models are often used to predict the pressure transients caused by hydrogen combustion in containments during postulated severe accidents. In the absence of data, these models account for prevailing flame acceleration mechanisms, such as initial turbulence, venting and obstacle-induced turbulence, by using arbitrarily large burning velocities that are much higher than laminar burning velocities. Using an intermediate-scale test facility at the Whiteshell Nuclear Research Establishment we have obtained necessary data on the effects of flame acceleration mechanisms, to estimate the safety margin in the buring velocities used in the models. So far, data have been analyzed, with a one-dimensional model, to determine effective burning velocities and burning-rate enhancement factors. The results of the analyses indicate that the effect of initial turbulence on the burning rate can be bounded only if the effect of flame-generated turbulence is included. The effect of venting can be accounted for by using two burning velocities, one for the pre-vent duration and a second increased value during the vented-combustion stage. The enhancement factors due to these two mechanisms, for the different conditions analyzed, varied up to 5.4, and the effective burning velocities varied up to 8.4 m/s.

45111 (AECL–9343) **Description of the blowdown test facility COG program on in-reactor fission product release, transport, and deposition under severe accident conditions.** Fehrenbach, P.J.; Wood, J.C. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Jun 1987. 29p. Order Number DE89636475/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Loss-of-coolant accidents with additional impairment of emergency cooling would probably result in high fuel temperatures leading to severe fuel damage (SFD) and significant fission product activity would then be transported along the PHTS to the break where a fraction of it would be released and transported. Under such conditions, there are many interacting and sometimes competing phenomena to consider. Laboratory simulations are being used to provide data on these phenomena, such as UO_2 oxidation and Zr-UO_2 interaction, from which mathematical models can be constructed. These are then combined into computer codes to include the interaction effects and assess the overall releases. In addition, in-reactor tests are the only source of data on release and transport of short-lived fission product nuclides, which are important in the consequence analysis of CANDU reactor accidents. Post-test decontamination of an in-reactor test facility also provides an opportunity to demonstrate techniques and obtain decontamination data relevant to post-accident rehabilitation of CANDU power reactors. Specialized facilities are required for in-reactor testing because of the extensive release of radioactive fission products and the high temperatures involved (up to 2500 degrees C.) To meet this need for the Canadian program, the Blowdown Test Facility (BTF) has been built in the NRU reactor at Chalk River. Between completion of construction in mid-1987 and the first Zircaloy-sheathed fuel test in fiscal year 1987/88, several commissioning tests are being performed. Similarly, extensive development work has been completed to permit application of instrumentation to irradiated fuel elements, and in support of post-test fuel assembly examination. A program of decontamination studies has also been developed to generate information relevant to post-accident decontamination of power reactors.

45112 (BNL–42823) **Hazard rate for a two-channel protective system subject to a high demand rate.** Oliveira, L.F.; Youngblood, R.; Melo, P.F.F. Brookhaven National Lab., Upton, NY (USA). 1989. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-76CH00016. (CONF-890855–50: 10. international conference on Structural Mechanics in Reactor Technology (SMIRT), 14-18 Aug 1989). Order Number DE89016123/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A basic figure of merit associated with a protective system for an industrial plant is the number of accidents expected to occur in the plant within a given period of time, with the system installed. By definition, in a plant equipped with a protective system, an accident can only happen if an initiating event (a demand) occurs while the protective system is unavailable, that is, while it is in one of its possible failed states. This means that the hazard rate or accident frequency depends on the demand rate and on the unavailability of the protective systems. It has long been recognized that the demand rate influences the unavailability of the protective system, and practical expressions incorporating that effect have been developed for single-channel and multi-channel protective systems. In a previous paper a Markovian approach was used to derive analytical expressions for the evaluation of the plant hazard rate for a single-channel protective system, properly accounting for the effects of the demand and the repair rates. In this paper, we present an extension of that model to the case of a plant equipped with a two-channel protective system. 5 refs., 3 figs.

45113 (CNEN-DR-GAPS-NT–03/88) **SEDA computer code and its utilization for Angra 1.** Fernandes Filho, T.L. Comissao Nacional de Energia Nuclear, Rio de Janeiro, RJ (Brazil). Dept. de Reatores. Nov 1988. 89p. (In Portuguese). Order Number DE89636467/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The implementation of SEDA 2.0 computer code, developed at Ezeiza Atomic Center, Argentine for Angra 1 reactor is described. The SEDA code gives an estimate for radiological consequences of nuclear accidents with release of radiactive materials for the environment. This code is now available for an IBM PC-XT. The computer environment, the files used, data, the programining structure and the models used are presented. The input data and results for two sample case are described. (author).

45114 (DOE/EH–0092) **Technical Safety Appraisal of the Feed Materials Production Center, Westinghouse Materials Company of Ohio.** USDOE Assistant Secretary for Environment, Safety, and Health, Washington, DC (USA). Jun 1989. 285p. Sponsored by U.S. DOE Environment Health & Safety. Order Number DE89017235/JAW. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

This TSA was the third in a series of Headquarters evaluations of FMPC that began in 1986. This latest TSA found a general trend of improved safety in the production areas of FMPC relative to the earlier evaluations. Improvement to date is largely the result of corrective actions taken in response to the specific concerns identified in the April 1986 and March 1988 evaluations rather than the product of an integrated safety program. A key finding of this appraisal is lack of an effective overall management control system to foster and guide the development of an integrated safety program for the site. Upper levels of contractor management have delivered the message of stewardship and individual responsibility for safety through corporate policy statements. However, observations during this TSA indicated that the management tools to assure follow-up and consistent safety performance across organizational elements were not effective. For example, significant overall improvement was found in safety documentation and the radiation protection program but poor performance in the Emergency Preparedness (EP) drill conducted for this TSA demonstrated little progress, perhaps regression, in the EP program.

45115 (DOE/NE/37970–T10) **Light water ultra-safe plant concept: Final report.** Klevans, E. Pennsylvania State Univ., University Park, PA (USA). Dept. of Nuclear Engineering. 25 May 1989. 112p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-86NE37970. Order Number DE89016452/JAW. Available from NTIS, PC A06/MF A01 - OSTI; INIS; GPO Dep.

Since the accident at Three Mile Island (TMI), Penn State Nuclear Engineering Department Faculty and Staff have considered various methods to improve already safe reactor designs and public perception of the safety of Nuclear Power. During 1987 and 1988, the Department of Energy provided funds to the Nuclear Engineering Department at Penn State to investigate a plant reconfiguration originated by M.A. Schultz called "The Light Water Ultra-Safe Plant Concept". This report presents a final summary of the project with references to several masters' theses and addendum reports for further detail. The two year research effort included design verification with detailed computer simulation of: (a) normal operation characteristics of the unique pressurizing concept, (b) severe transients without loss of coolant, (c) combined primary and secondary system modeling, and (d) small break and large break loss of coolant accidents. Other studies included safety analysis, low power density core design, and control system design to greatly simplify the control room and required operator responses to plant upset conditions. The overall conclusion is that a reconfigured pressurized water reactor can achieve real and perceived safety improvements. Additionally, control system research to produce greatly simplified control rooms and operator requirements should be continued in future projects.

45116 (EUR–11608, pp. 145-159) **Application of the general principles of radiation protection.** Coulon, R. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Dept. de Protection Sanitaire). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8710489–: 1. meeting of the standing conference on health and safety in the nuclear age, 5-7 Oct 1987). In *Health and safety in the nuclear age*. Order Number DE89908200/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

The characteristic feature of radiation protection is that of a unitary approach vis-a-vis a coherent set of concepts and general principles and the ensuing systems of standards. This situation creates favourable conditions for guaranteeing quality control. However, the benefit of radiation protection would be limited if the doctrine, principles and standards were merely a theoretical administrative and technocratic system: it is essential that these doctrines, principles and standards should lead to concrete action at all stages of development, from design right up to daily operational procedures. This requires on the part of all those involved, and at all levels, a spirit of discipline and openness where there must be both common sense and respect for the rules. It also requires the constraint of the regulation which is comprehensive, precise, clear and which cannot

be evaded. In short, it must be enforceable. Even if the situation in the nuclear industry vis-a-vis radiological safety cannot be called ideal, it is totally satisfactory, both for members of the public and for workers. This is the main topic developed in the report.

45117 (EUR–11755) **Aerosol measurements and nuclear accidents: a reconsideration.** Raes, F. (ed.). Commission of the European Communities, Luxembourg (Luxembourg). 1988. 165p. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). Available from NTIS (US Sales Only), PC A08/MF A01.

Within its radioactivity environmental monitoring programme, the Commission of the European Communities and in particular its Joint Research Centre wants to encourage the qualitative improvement of radioactivity monitoring. On 3 and 4 December 1987 an experts' meeting has been organized by the Ispra Joint Research Centre in collaboration with the Gesellschaft fuer Aerosolforschung, in order to discuss measuring techniques for radioactive aerosols in the environment in case of a nuclear accident. During the workshop, current practices in routine monitoring programmes in the near and far field of nuclear power plants were confronted with the latest developments in the metrology of aerosols and radioactivity. The need and feasibility of implementing advanced aerosol and radioactivity techniques in routine monitoring networks have been discussed. This publication gives the full text of 12 presentations and a report of the roundtable discussion being held afterwards. It does not intend to give a complete picture of all activities going on in the field of radioactive aerosol metrology; it rather collects a number of common statements of people who approach the problem from quite different directions.

45118 (EUR–11755, pp. 1-10) **Deposition of particles and iodine to outdoor surfaces and in the respiratory tract.** Garland, J.A. (UKAEA Harwell Lab.). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Dry deposition of particles depends strongly on particle size, and is also influenced by the geometry of the surface and weather parameters. Precipitation scavenging is also influenced to some degree by particle size, but hygroscopic properties of soluble particles are also likely to enhance deposition in precipitation. Similar comments apply in the respiratory tract, where particle size and solubility may influence the extent and site of deposition: the site is important for insoluble particles at least since it determines retention time in the body. Thus measurement of particle size and investigation of solubility would be valuable in interpreting deposition inhalation and air concentration observations. Iodine has several chemical forms in the air. It is valuable to sample in such a way that different forms are partitioned, although there is some uncertainty in their identification. The rate of deposition to vegetation depends strongly on the chemical form of the iodine, but the vapour forms of iodine that occur in the atmosphere may all be retained efficiently on inhalation.

45119 (EUR–11755, pp. 16-25) **Harwell fallout monitoring programme and its response to the Chernobyl accident.** Cambray, R.S. (UKAEA Harwell Lab.). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The Harwell laboratory operates a worldwide network of air and rain sampling stations for radioactivity in the atmosphere. In the months after the Chernobyl accident of 29 April 1986 the network was used to study the distribution and behaviour of radioactive debris from that source. An estimate of 5×10^{16} Bq of caesium-137 has been deduced for the global distribution from Chernobyl.

45120 (EUR–11755, pp. 26-35) **Strategies and experience of environmental air contamination measurements for accidental conditions.** Devell, L. (Studsvik Science Research Lab., Nykoeping (SE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Experience obtained from the Chernobyl accident can be used for the improvement of suitable emergency measurement systems in case of a nuclear accident. The following systems are discussed in the paper: - stationary filter stations in the vicinity of nuclear installations; - portable filters for particular radioactivity; - regional or national network for detection of air contamination; - regional or national networks for fast detection and alarm of increased radiation dose levels; - follow-up systems to characterize the air contamination. With regard to the systems used in Sweden the following conclusions are drawn: - after the completion of the automatic alarming gamma monitoring stations an adequate system is available; - the network of air filter stations seems appropriate for the supervision of the air contamination level. Provisions for noble gas measurements and adequate iodine sampling could be reasonable improvements in the future; - possibilities for particle size determinations and hot particle analysis are desirable; - recent advances in real time prognosis of atmospheric dispersion and dose calculations must be considered in future improvements.

45121 (EUR–11755, pp. 93-105) **Particle size distribution measurements of radionuclides from Chernobyl.** Georgi, B. (Niedersachsisches Inst. fuer radiooeokologie, Hannover (DE)); Tschiersch, J. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Characteristics of the size distribution of the Chernobyl aerosol have been measured at four locations along the trajectory of the cloud. Changes in time and differences between ^{131}I and the other isotopes are explained by aerosol physical processes. The relevance of the measurements for dose calculations are discussed.

45122 (EUR–11755, pp. 11-15) **Nuclear accidents-monitoring during different phases.** Apsimon, H.M. (Imperial Coll. of Science and Technology, London (UK)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

This paper reviews the different phases of a nuclear accident in an attempt to set the context for the various radiological measurements which may be undertaken.

45123 (EUR–11755, pp. 106-117) **Samplings of airborne particulates for granulometric determinations following Chernobyl accident.** Tarroni, G. (ENEA, Casaccia (IT). Centro Ricerche Energia); Calamosca, M.; Zaiacomo, T. de; Gragnani, R.; Michetti, I.; Testa, L. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Particle size distributions and concentrations of the radioactive aerosol that arose from the Chernobyl accident were determined in Bologna and Rome. The activity Median Aerodynamic Diameters (AMAD) of Ru-103, Te-132, Cs-134 and Cs-137, determined by means of impactors, were in the range 0.8 - 1.4 μm with Geometric Standard Deviations (Sg) in the range 1.6 - 3.7. Lower AMAD and higher Sg values were found for I-131 compared to those for the other radioisotopes. The gaseous fraction of I-131 was 60-70% of the total aerosuspended activity of this isotope. A comparison between direct measurement data concerning internal contamination on volunteers and values derived from air contamination data shows that in Bologna, during May 1986, almost all the contamination was due to inhalation. The data are unable to distinguish between different inhalation models.

45124 (EUR–11755, pp. 118-124) **Air activity concentrations and aerosol activity size distributions after the accident at Chernobyl.** Porstendoerfer, J. (Goettingen Univ. (DE)); Reineking,

A. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The activity concentration of the Chernobyl aerosol was measured from April 29, 1986 till December 1986. In addition measurements were carried out with charcoal filters which showed that only 15-23% of the total ^{131}I was adsorbed on aerosol particles. The activity size distributions of the aerosol were measured by means of a low pressure cascade impactor (Type BERNER) and a high volume cascade impactor (Type SIERRA). Most of the measurements yielded unimodal distributions with activity median aerodynamic diameters (AMAD) in the size range 700-1000 nm. Sometimes the size distributions were bimodal with a significant activity amount on a coarse mode with sizes greater 2000 nm. The iodine distributions were shifted to smaller particle diameters with an average median value near 600 nm. In some air samples single "hot" particles of the isotopes $^{95}Zr/^{95}Nb$, ^{141}Ce and ^{144}Ce were measured only in the coarse size mode.

45125 (EUR–11755, pp. 156-165) **Aerosol measurements and nuclear accidents: a reconsideration, report of the round table discussion.** Raes, F. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Radioactivity Environmental Monitoring (REM) is commonly divided into routine and emergency monitoring. Routine REM must demonstrate the adequacy of controls on releases as well as the compliance with radiological standards. It should also be able to give an early warning in case of abnormal concentrations, so that emergency REM may be initiated promptly. It should be clear, however, that stack monitoring and other in-plant measurements are the primary information sources for abnormal conditions. Emergency REM should rapidly assess the extent of an accident and provide the information needed for taking countermeasures. The collection of in-depth information on environmental processes for model validation is usually considered as an additional benefit of both routine and emergency REM. In discussing techniques for measuring radioactive aerosols, in particular the need for new and more sophisticated techniques, one must consider the objectives of REM, define how much weight should be given to each of them, and investigate whether new techniques might help in meeting the objectives. The opinions of the experts are organized into three chapters: the first compiles experiences and opinions about radioactive aerosol monitoring and defines the experimental needs for such monitoring with respect to early warning and early assessment in case of nuclear accidents; the second chapter discusses radioactive aerosol monitoring from the point of view of the scientist who wants to increase or validate his knowledge about the behaviour of radionuclides in the atmosphere; the third chapter reviews recent developments in field of aerosol and nuclear metrology and their interest for nuclear safety. Each chapter ends with a number of conclusions and recommendations.

45126 (GRS–69) **Research for enhancing reactor safety.** Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. 110p. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Recent research for enhanced reactor safety covers extensive and numerous experiments and computed modelling activities designed to verify and to improve existing design requirements. The lectures presented at the meeting report GRS research results and the current status of reactor safety research in France. The GRS experts present results concerning expert systems and their perspectives in safety engineering, large-scale experiments and their significance in the development and verification of computer codes for thermohydraulic modelling of safety-related incidents, the advanced system code ATHLET for analysis of thermohydraulic processes of incidents, the analysis simulator which is a tool for fast evaluation of accident management measures, and investigations into event sequences and the required preventive emergency measures within the German Risk Study. (DG).

45127 (GRS–69, pp. 15-21) **Reactor safety research - results and perspectives.** Banaschik, M. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety.* Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The work performed so far is an essential contribution to the determination of the safety margins of nuclear facilities and their systems and to the further development of safety engineering. The further development of safety engineering involves a shift of emphasis in reactor safety research towards event sequences beyond the design basis. The aim of this shift in emphasis is the further development of the preventive level. This is based on the fact that the conservative design of the operating and safety systems involves and essential safety potential. The R and D work is intended to help develop accident management measures and to take the plant back into the safe state even after severe accidents. In this context, it is necessary to make full use of the safety margins of the plant and to include the operating systems for coping with accidents. As a result of the aims, the research work approaches operating and plant-specific processes. (orig./DG).

45128 (GRS–69, pp. 22-33) **Reactor safety research in France.** Bussac, J. (Institut de Protection et de Surete Nucleaire, 92 - Fontenay-aux-Roses (France)); Zammite, R. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety.* Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The paper deals withs PWR research only and covers programs performed in CEA or in cooperation between CEA and EDF or Framatome. Emphasis is being given to core cooling faults and associated procedures, primary circuit two-phase thermohydraulics, core damage, safeguarding of confinement, evaluation of accidental releases, and management of accident consequences. Most of the design and construction adequacy problems have already been solved in a generic manner, nevertheless new designs are now being studied and may require complementary research. (DG).

45129 (GRS–69, pp. 34-45) **Perspectives of expert systems in the field of reactor safety.** Bastl, W. (Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.)). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety.* Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The furure potential of expert systems is based on the following factors: the efficient storage of information in the knowledge basis, the efficient use of comprehensive information bases, the interactive approach, the rapid production of prototypes. The main problems which are encountered at present relate to the input of knowledge derived from experience, the qualification of the contents of the knowledge bases and to the interfacing to technical processes, as real time work is required in such cases. However, the practical use of expert systems in reactor safety is expected to make considerable progress. The following preferred fields should be mentioned: knowledge bases and analysis tools for safety investigations, diagnostic and practising systems for safe operation and, above all in the field of accident management, trainers, in-situ guiding systems or information systems in supraregional guiding centers. (orig./DG).

45130 (GRS–69, pp. 46-59) **Significance of large-scale experiments for the development and verification of thermohydraulics computer codes.** Wolfert, K.; Riegel, B.; Sonnenburg, H. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany,

F.R.). May 1989. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety*. Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

For both the development and the verification of computer codes large-scale experiments are of particular importance. Large-scale experiments are understood as single effect experiments where reactor components are modelled at a scale of 1:1 (UPTF) and as integral experiments involving the modelling of primary and secondary circuits. Single effect experiments involving a modelling of reactor components at a scale 1:1 constitute the basis of a purposeful development and verification of models for the description of large-volume phenomena such as they are anticipated in the reactor plant. Integral experiments (PKL, LOBI) permit the verification of the interaction of all the individual models. A systematic approach in the development and verification ensures both a realistic description of the physical phenomena to be anticipated in the reactor plant and a comprehensive verification of the entire program. (orig./DG).

45131 (GRS–69, pp. 60-69) **ATHLET - an advanced system code for the analysis of thermohydraulic processes.** Teschendorff, V.; Miro, J.; Lerchl, G. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety*. Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The ATHLET computer code which is being developed by GRS is intended to cover, by means of a single code, the entire spectrum of loss-of-coolant accidents and transient accidents in pressurized water and boiling water reactors, whereas so far three codes with different fields of application have been necessary for this purpose. The future spectrum of tasks also comprises incidents beyond the design basis and core meltdown accidents which have to be calculated as realistically as possible in order to avoid wrong conclusions. For this purpose, the validity of the models must be extended and the degree of detail of the simulation increased. In cooperation with the University of Stuttgart, an ATHLET-SA version is being prepared for accidents involving the destruction of the reactor core; this version also contains models for core meltdown and fission product behavior. The aim of the ATHLET concept is to provide the user with models of different degree of detail within a uniform pattern of codes. The entry of data is userfriendly and permits a visual inspection of the entry of the program for the geometric plant data by means of a clear graphic display. (orig./DG).

45132 (GRS–69, pp. 70-81) **Analysis simulator, a tool for the evaluation of accident management measures.** Beraha, D.; Lerchl, G.; Voggenberger, T. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety*. Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The analysis simulator is a manifold and variable engineered tool which permits the interactive handling of very comprehensive model codes and offers the wealth of information calculated by the models in a condensed and uncluttered way by means of graphic displays. The first phase of work on the simulator concentrated on the development of interfaces, interactivity and communication. The experience gathered so far and the case study, in which an accident management measure is taken to prevent a severe accident, show both the advantages of the analysis simulator and its limitations as far as the speed of simulation, its sturdiness and the extent of the models are concerned. The continuation of work on the analysis simulator and the test control room will further extend these limits in order to fully comply with the requirements for the simulation of measures oriented towards certain aims of protection. (orig.).

45133 (GRS–69, pp. 82-98) **Event sequences with accident management measures in the German risk study.** Heuser, F.W.; Hoertner, H.; Kersting, E. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety*. Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The paper first deals with the results of the investigations in the field of systems engineering as carried out in Phase B of the German Risk Study. Accordingly, the total frequency of event sequences which are not coped with by the safety systems amounts to approx. $5x10^{-5}$ per year, without considering accident management measures. Even in a far-reaching failure of safety systems, accident management measures can be used to prevent a core meltdown accident or mitigate its consequences. Investigations of the efficiency of preventive emergency measures are presented. The possible implementation of 'bleed and feed' measures on both the secondary and the primary side and their influence on the frequency of high-pressure and low-pressure core meltdown accidents are discussed. Thus, the frequency with respect to core meltdowns can be reduced, and in most cases a high-pressure core meltdown can be prevented. Furthermore, mitigating accident management measures are addressed which are used for the preservation of the retention function of the containment. (orig.).

45134 (GRS-F–175) **List of reports in the field of reactor safety research of BMFT, CEA, EPRI, JSTA and USNRC. Reported period: January 1 to March 31, 1989.** Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.). May 1989. 57p. (In German). Order Number DE89915117/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This list reviews reports from the Federal Republic of Germany, from France, from Japan and from the United States of America concerning single problems in the field of Reactor Safety Research. According to the cooperation of the Bundesminister fuer Forschung und Technologie (BMFT) with the Commissariat a l'Energie Atomique (CEA), the Japan Science and Technology Agency (JSTA), the Electric Power Research Institute (EPRI) and the United States Nuclear Regulatory Commission, these reports are available in the Gesellschaft fuer Reaktorsicherheit (GRS). The list pursues the following order: Country of origin, problem area concerned, according to the Reactor Safety Research Programme of the BMFT, reporting organization. The list of reports appears quarterly. (orig.).

45135 (INIS-mf–11505) **Emergency response guide for Point Lepreau area residents.** New Brunswick Emergency Measures Organization, Point Lepreau (Canada). 1982. 40p. (In English, French). Order Number DE89636504/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included.

The design, construction and operating procedures of CANDU nuclear generating stations ensure that an accident causing a significant risk to people living near these stations is extremely unlikely. However, despite the excellent safety record of nuclear stations, it is common practice to prepare an emergency plan for such facilities. In this regard, The New Brunswick Emergency Measures Organization is responsible for developing and implementing the Off-Site Emergency Plan for the Point Lepreau Generating Station. Work for the Off-Site Emergency Plan began in 1976 and, under the leadership of N.B.E.M.O., a number of government agencies co-operated in this project. The completed plan thus represents agreement among a number of Province of New Brunswick departments, various community groups, NB Power, and representatives of the Government of Canada. Also, information gathered in the annual door-to-door survey of the Lepreau area enabled government planners to make specialized arrangements such as an extensive warden service, a siren system, and evacuation assistance for the disabled.

45136 (Juel-Spez–487) **Spherical fuel elements with TRISO particles at accident temperatures. Experimental data to the report Juel-2091 and new results from 1986 to October 1988.** Schenk, W.; Nabielek, H. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorwerkstoffe. Jan 1989. 244p. (In German). Order Number DE89914975/JAW. Available from NTIS (US Sales Only), PC A11/MF A01.

At 1600°C, fission product release from spherical fuel elements is limited to the contribution of the contamination, since the particles

remain intact. An exception to this is Ag 110m. At 1800°C, deterioration of the SiC layer can be observed to various degrees leading to cesium release from individual coated particles and the buildup of cesium in the matrix graphite of the fuel element. Release from the sphere is observed only after some delay. Strontium is still strongly retained in fuel kernels and in the matrix graphite. Largest release fractions are observed with silver which diffuses fast through matrix graphite. Starting at 1800°C, and increasing with higher temperatures, release of fission gases and iodine is getting larger due to occasional pressure induced particle failures and due to SiC corrosion and thermal decomposition. Gas release levels can reach 0.1% after heatup to 1800°C and 14% after heatup to 2500°C. Under these heating conditions, cesium release is 1-6%, and 100%, respectively. The most important conclusion is that the release of all safety relevant radionuclides is negligible for temperatures up to 1600°C and heating times up to 500 hours. At 1700°C and 1800°C, fission product retention in fuel elements with TRISO particles is strongly dependent on the heating time and also on the prior irradiation conditions. (orig./HP).

45137 (NUREG–0713-Vol.8) **Occupational radiation exposure at commercial nuclear power reactors and other facilities 1986: Nineteenth annual report.** Brooks, B.G.; Hagemeyer, D. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Regulatory Applications; Science Applications International Corp., McLean, VA (USA). Aug 1989. 248p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A11/MF A01 - GPO - OSTI.

This report summarizes the occupational exposure data that are maintained in the US Nuclear Regulatory Commission's Radiation Exposure Information and Reporting System (REIRS). The bulk of the information contained in the report was extracted from the 1986 annual statistical reports submitted by six of the seven categories of NRC licensees subject to the reporting requirements of 10 CFR § 20.407. Since there are no geologic repositories for high level waste currently licensed, only six categories will be considered in this report. These six categories of licensees also submit personal identification and exposure information for terminating employees pursuant to 10 CFR § 20.408, and some analysis of this "termination" data is also presented in this report. Annual report for 1986 were received from a total of 482 NRC licensees, 101 of whom were licensed nuclear power reactors. Compilations of the 482 reports indicated that some 227,652 individuals were monitored, 116,241 of whom received a measurable dose (Table 3.1). The collective dose incurred by these individuals was calculated to be 46,366 person-rems (person-cSv) which represents a decrease of 23% from the 1985 value. The number of workers receiving a measurable dose increased while the collective dose decreased slightly, causing the average measurable dose to decrease from 0.43 rem (cSv) to 0.40 rem (cSv). About 13% of the monitored individuals were found to have received doses greater than 0.50 rem (cSv), which is about the same as the value for 1985. 16 refs., 11 figs., 26 tabs.

45138 (NUREG–0991-Suppl.8) **Safety evaluation report related to the operation of Limerick Generating Station, Units 1 and 2 (Docket Nos. 50-352 and 50-353).** Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Reactor Regulation. Jun 1989. 66p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO; OSTI; INIS.

In August 1983 the staff of the Nuclear Regulatory Commission issued its Safety Evaluation Report (NUREG-0991) regarding the application of the Philadelphia Electric Company (the licensee) for licenses to operate the Limerick Generating Station, Units 1 and 2, located on site in Montgomery and Chester Counties, Pennsylvania. Supplement 1 to NUREG-0991 was issued in December 1983. Supplements 2 and 3 were issued in October 1984. License NPF-27 for the low-power operation of Limerick Unit 1 was issued on October 26, 1984. Supplement 4 was issued in May, 1985, Supplement 5 was issued in July 1985, and Supplement 6 was issued in August 1985. These supplements addressed further issues that required resolution before Unit 1 proceeded beyond the 5-percent power level. The full-power operating license for Limerick Unit 1 (NPF-39) was issued August 8, 1985, and the unit has completed two cycles of operation. Supplement 7 was issued April 1989 to address some of the few significant design differences between Units 1 and 2, the resolution of issues that remained open when the Unit 1 full-power license was issued and an assessment of some of the issues that required resolution before issuance of an operating license for Unit 2. This supplement addresses the remaining issues that required resolution before issuance of and operating license for Unit 2.

45139 (NUREG/CP–0097-Vol.1, pp. 11-32) **Severe accident research in the United Kingdom.** Tyror, J.G. (UKAEA, Warrington (England)); Garnsey, R.; Hicks, D. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The United Kingdom position on severe accidents reflects two essential facts. First, the large potential social impact of such events makes their avoidance and control a matter of special concern. Second, their rarity means that world-wide experience of them is very limited. Understanding of severe accidents must therefore be based on predictive models, validated against a wide variety of experiments, and of course, against such accident experience as is available. In this paper, in order to provide a background to the UK research program, the general principles are explained on which control and avoidance of severe accidents are based in the UK. How these principles have developed in practice in the UK PWR program is then discussed, using as an example the Sizewell B Public Inquiry. Finally two examples of the UK severe accident research are described: the work on steam explosions and on fission product chemistry.

45140 (NUREG/CP–0097-Vol.1, pp. 47-72) **Decontamination impacts on solidification and waste disposal.** Kempf, C.R. (Brookhaven National Lab., Upton, NY (USA)); Soo, P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

Research to determine chemical and physical conditions which could lead to thermal excursions, gas generation, and/or general degradation of decontamination-reagent-loaded resins has shown that IRN-78, IONAC A-365, and IRN-77 organic ion exchange resin moisture contents vary significantly depending on the counter ion loading. For these resins the EDTA, picolinic acid and Fe^{+2} loaded forms, respectively, had moisture contents lower than the regenerated, OH^- and H^+ loaded forms. Heat- and gas-generating reactions have occurred with two anion resins used, IRN-78 and IONAC A-365; color changes and precipitates were also observed. The resins were originally in the OH^- form and potassium permanganate and nitric acid were oxidizing solutions used to produce the reactions. The extent/vigor of the reaction is very highly dependent on the degree of dewatering of the resins and (probably linked to this) on the method of solution addition (dropwise or in bulk). The heat generation may be due, in part, to the heat of neutralization (acid addition to hydroxide-form resins). Ferrous ion loaded cation resins (IRN-77) showed little reactivity toward nitric acid and potassium permanganate. In studies of the long-term compatibility effects of decontamination waste resins in contact with waste package container materials in the presence of decontamination reagents, radiolysis products and gamma irradiation, it has been found that the corrosion of carbon steel and austenitic stainless steel in mixed bed resins is enhanced by gamma irradiation. However, cracking in high density polyethylene is essentially eliminated because of the rapid removal of oxygen from the environment by gamma-induced oxidation of the large resin mass. Ferralium-255 and TiCode-12 are not attacked even for gamma doses up to 10_8 rad.

45141 (NUREG/CP–0097-Vol.1, pp. 119-128) **Evaluation of nuclear facility decommissioning projects (ENFDP) - program status.** Haffner, D.R. (Westinghouse Hanford Co. (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The Evaluation of Nuclear Facility Decommissioning Projects program was undertaken by the US Nuclear Regulatory Commission to compile and evaluate the activities of completed and ongoing decommissioning projects. This report discusses briefly, the status of those decommissioning projects selected for this study with emphasis on ongoing projects.

45142 (NUREG/CP–0097-Vol.1, pp. 163-170) **NUMARC view of license renewal criteria.** Edwards, D.W. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The Atomic Energy Act and the implementing regulations of the US Nuclear Regulatory Commission (NRC) permit the renewal of nuclear plant operating licenses upon expiration of their 40-year license term. However, the regulatory process by which license renewal may be accomplished and the requirements for the scope and content of renewal applications are yet to be established. On August 29, 1988, the NRC published an Advanced Notice of Proposed Rulemaking regarding the subject of license renewal. This Advanced Notice and the NUREG which it references, NUREG-1317, Regulatory Options for Nuclear Plant License Renewal, provide the most recent regulatory thought on this issue. The basic issue addressed by NUREG-1317 is the definition of an adequate licensing basis for the renewal of a plant license. The report contemplates three alternatives in this regard. This paper discusses each of these three proposals. The NUMARC NUPLEX Working Group endorses a license renewal process based on a plant's current licensing basis along with an evaluation of the pertinent components, systems, and structures affected by age-related degradation. The NUMARC NUPLEX Working group believes that an appropriate scope for NRC review of the license renewal application should focus on those safety-significant structures systems, and components subject to significant age-related degradation that are not subject to existing recognized effective replacement, refurbishment, or inspection programs. The paper also briefly discusses NUMARC's view of the role of the Backfit Rule in the license renewal process.

45143 (NUREG/CP–0097-Vol.1, pp. 185-190) **Overview of the NRC's human factors regulatory research program.** Coffman, F.D. Jr. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

At the NRC, human performance research is directed toward the technology needed to ensure the safe and effective use of commercial nucleonics by people. Human performance research has many factors and is a broadly based technology. The research is grouped into six topical areas to facilitate the research: (1) Human Performance and Human Reliability Assessment, (2) Man-Machine Interfaces, (3) Procedures, (4) Qualifications and Training, (5) Organization and Management, and (6) Performance Indicators. However, even these groups are closely interrelated and not totally separable because the individual elements of human factors research are not readily separable.

45144 (NUREG/CP–0097-Vol.1, pp. 219-228) **Human performance data acquisition and management for reliability evaluations.** Gertman, D.I. (Idaho National Engineering Lab., Idaho Falls (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The Nuclear Computerized Library for Assessing Reactor Reliability (NUCLARR) is an automated data base management system used to process, store and retrieve human error probability (HEP) and hardware component failure rate data in a ready to use format. The data base has now been implemented and efforts continue to identify and process qualified sources of data. A Clearinghouse function has been established at the Idaho National Engineering Laboratory (INEL) to: handle requests for data, issue software, answer user questions, and publish NUREG/CR-4639 Volume IV: User's Guide. In order to reflect the continual addition of data to NUCLARR, the Clearinghouse issues update pages to Volume V: Data Manual. This presentation summarizes existing HEP data in terms of the type of plant systems, components and displays, controls and indicators used by plant personnel. Most NUCLARR data comes from NUREG, laboratory or consensus expert judgement sources. Suggestions are made regarding obtaining and processing additional data from root cause data bases, sister industries, and the international community at large.

45145 (NUREG/CP–0097-Vol.1, pp. 229-242) **Staffing, overtime, and shift scheduling project.** Lewis, P.M. (Pacific Northwest Lab., Richland, WA (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

Recent events at the Peach Bottom nuclear power plant have demonstrated the need to establish a quantifiable basis for assessing the safety significance of long work hours on nuclear power plant operators. The incidents at TMI-2, Chernobyl, and Bhopal, which all occurred during the late evening/night shift, further highlight the importance of the relationship between shift scheduling and performance. The objective of this project is to estimate, using statistical analysis on data from the nuclear industry, the effects on safety of staffing levels, overtime, and shift scheduling for operators and maintenance personnel. Regarding staffing levels, the Nuclear Regulatory Commission (NRC) currently has no explicit regulation concerning the minimum acceptable levels of staffing in a plant that has an operating license. The NRC has no systematic method for collecting data on the number of licensed operators on the operating crews. In 1982 the NRC recommended that plants write into their technical specifications a model policy on overtime. Currently, 77 nuclear power plant units have the model policy or a modification of it written into their technical specifications; 33 units have no policy on overtime. The model policy sets limits on overtime for safety related personnel, although these limits can be exceeded with plant manger approval. The US nuclear power industry has three types of shift schedules: (1) forward-rotating 8-hour/day shift schedules, (2) backward-rotating 8-hour/day schedules, and (3) 12-hour/day schedules.

45146 (NUREG/CP–0097-Vol.1, pp. 253-264) **Generic implications of the Chernobyl accident.** Sege, G. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The US Nuclear Regulatory Commission (NRC) staff's assessment of the generic implications of the Chernobyl accident led to the conclusion that no immediate changes in the NRC's regulations regarding design or operation of US commercial reactors are needed. However, further consideration of certain issues was recommended. This paper discusses those issues and the studies being addressed to them. Although 24 tasks relating to light water reactor issues are identified in the Chernobyl follow-up research program, only four are new initiatives originating from Chernobyl implications. The remainder are limited modifications of ongoing programs designed to ensure that those programs duly reflect any lessons that may be drawn from the Chernobyl experience. The four new study tasks discussed include a study of reactivity transients, to reconfirm or bring into question the adequacy of potential reactivity accident sequences hitherto selected as a basis for design approvals; analysis of risk at low power and shutdown; a study of procedure violations; and a review of current NRC testing requirements for balance of benefits and risks. Also discussed, briefly, are adjustments to ongoing studies in the areas of operational controls, design, containment, emergency planning, and severe accident phenomena.

45147 (NUREG/CP–0097-Vol.1, pp. 513-520) **Integral fast reactor.** Chang, Y.I. (Argonne National Lab., IL (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

The Integral Fast Reactor (IFR) is an innovative liquid metal reactor concept being developed at Argonne National Laboratory. It seeks to specifically exploit the inherent properties of liquid metal cooling and metallic fuel in a way that leads to substantial improvements in the characteristics of the complete reactor system. This paper describes the key features and potential advantages of the IFR concept, with emphasis on its safety characteristics.

45148 (NUREG/CP–0097-Vol.1, pp. 521-540) **ORNL R and D on advanced small and medium power reactors: selected topics.** White, J.D. (Oak Ridge National Lab., TN (USA)); Trauger, D.B. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. DOE Contract AC05-84OR21400. (CONF-8810155–Vol.1: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Volume 1: Plenary session, Decontamination and decommissioning, License renewal, Human factors, generic issues, Risk analysis/PRA applications, Innovative concepts for increased safety of advanced power reactors.* Order Number DE89012565/JAW. Available from NTIS, PC A24/MF A01 - I.

From 1984-1985, ORNL studied several innovative small and medium power nuclear concepts with respect to viability. Criteria for assessment of market attractiveness were developed and are described here. Using these criteria and descriptions of selected advanced reactor concepts, an assessment of their projected market viability in the time period 2000-2010 was made. All of these selected concepts could be considered as having the potential for meeting the criteria but, in most cases, considerable R and D would be required to reduce uncertainties. This work and later studies of safety and licensing of advanced, passively safe reactor concepts by ORNL are described. The results of these studies are taken into account in most of the current (FY 1989) work at ORNL on advanced reactors. A brief outline of this current work is given. One of the current R and D efforts at ORNL which addresses the operability and safety of advanced reactors is the Advanced Controls Program. Selected topics from this Program are described.

45149 (NUREG/CP–0097-Vol.4, pp. 299-312) **MIST program: summary of key results.** Gloudemans, J.R. (Babcock and Wilcox, Lynchburg, VA (USA)); Birmingham, D.P. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Brookhaven National Lab., Upton, NY (USA). Mar 1989. (CONF-8810155–Vol.4: 16. water reactor safety information meeting, 24-27 Oct 1988). In *Sixteenth water reactor safety information meeting. Proceedings: Volume 4, Code uncertainty for ECCS rule; international code assessment program; thermal hydraulics; 2D/3D data applications.* Available from NTIS, PC A99/MF A01 - I.

The multiloop integral system test (MIST) was part of a multiphase program started in 1983 to address small-break loss-of-coolant accidents (SBLOCAs) specific to Babcock and Wilcox-designed plants. Data from MIST are used to benchmark the adequacy of system codes, such as RELAP5 and TRAC, for predicting abnormal plant transients. In 1982, a Test Advisory Group (TAG) was formed to identify experimental data needs for the Babcock and Wilcox-designed nuclear steam system. The TAG developed a list of 17 issues perceived both to lack experimental data and to be of sufficient interest that such data were needed. The issues were grouped under four major topics: natural circulation, small-break loss-of-coolant accidents, feed and bleed, and steam generator tube rupture. The MIST facility was scaled, designed, and tested to address these issues. The MIST tests addressed each of the 17 TAG issues. A wealth of consistent integral system data has been generated for each issue. An important issue under the topic of natural circulation was the ability of boiler-condenser mode natural circulation to remove core heat and effectively depressurize the reactor coolant. In this program, the viability of this mode of primary-to-secondary heat transfer was repeatedly observed. When the prerequisite conditions for boiler-condenser mode were met, the primary system tended to depressurize through vapor condensation and the accompanying primary-to-secondary heat transfer. The ability of the reactor vessel vent valves to augment primary system depressurization during the simulated SBLOCAs was also observed in MIST. MIST repeated exhibited system resiliency to imposed changes in the primary boundary conditions as a result of the steam venting capabilities of the reactor vessel vent valves. The ability of feed and bleed cooling to provide continual core cooling as well as system cooldown and depressurization was demonstrated in MIST.

45150 (NUREG/CP–0098-Vol.2, pp. 695-708) **Filtered containment venting in Sweden.** Lindau, L. (Flaekt IP AB, Vaexjoe (Sweden)); Ellisson, K. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

After the TMI accident, Swedish authorities decided that all Swedish nuclear power plants should be upgraded with respect to mitigation of the consequences of severe accidents. One contribution to meet these ends is filtered containment venting, i.e. means to relieve containment overpressure and to clean the relief gas from radioactive components. The first system in operation was built at the Barsebaeck site (2 BWR's) where a gravel bed filter was installed. For the remaining Swedish units (7 BWR's and 3 PWR's) a passive, self-controlling wet scrubber system, FILTRA-MVSS, is now under installation. The principle of the FILTRA-MVSS is a self-controlling, self-pumping venturi collector submerged in a pool, and it is used to filter out emissions of solid and gaseous radioactive components.

45151 (NUREG/CP–0098-Vol.2, pp. 709-725) **Off-gas cleaning devices for containment venting system.** Dillmann, H.G. (Kernforschungszentrum Karlsruhe GmbH (Germany, F.R.)); Pasler, H.; Wilhelm, J.G. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference,

22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Failure of the containment of a pressurized water reactor as a consequence of a major reactor accident can be prevented by filtered containment venting into the stack through an accident filter system. This greatly reduces the environmental contamination by fission products which, otherwise, would have been released. Possible filter concepts and their embodiment in stainless steel fiber filters are described.

45152 (NUREG/CR–2331-Vol.9-No.1) **Safety research programs sponsored by Office of Nuclear Regulatory Research: Progress report, January 1–March 31, 1989.** Weiss, A.J. (comp.). Nuclear Regulatory Commission, Washington, DC (USA); Brookhaven National Lab., Upton, NY (USA). Aug 1989. 151p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC02-76CH00016. (BNL-NUREG–51454-Vol.9-No.1). Available from NTIS, PC A08/MF A01 - GPO - OSTI.

This progress report describes current activities and technical progress in the programs at Brookhaven National Laboratory sponsored by the Division of Regulatory Applications, Division of Engineering, Division of Safety Issue Resolution, and Division of Systems Research of the US Nuclear Regulatory Commission, Office of Nuclear Regulatory Research following the reorganization in July 1988. The previous reports have covered the period October 1, 1976 through December 31, 1988.

45153 (SAND–88-2171C) **Equipment qualification risk scoping analyses: Results and conclusions.** Bustard, L.D.; Kolaczkowski, A.M. Sandia National Labs., Albuquerque, NM (USA). [1989]. 8p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC04-76DP00789. (CONF-890911–6: International conference on operability of nuclear systems in normal and adverse environments, 18-22 Sep 1989). Order Number DE89011537/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Probabilistic risk assessment (PRA) techniques and insights have been employed during an investigation entitled the Equipment Qualification (EQ)-Risk Scoping Study to assess the risk significance of equipment qualification issues. This approach for evaluating EQ issues suggests that some issues are not risk significant while some have a significant potential to increase risk. For example, EQ issues associated with long term accident equipment operability are not risk significant. Alternatively, there are selected system operations that require equipment not qualified for important accident environments. Though the study demonstrated that PRA does provide insights that modify perceptions regarding the importance of various EQ issues, it should be noted that PRA methods currently cannot define the risk significance for some EQ issues. Additional discussion regarding the study's results and conclusions is provided. 6 refs.

45154 (SAND–89-1863C) **NUREG-1150 methodology review.** Jow, Hong-Nian. Sandia National Labs., Albuquerque, NM (USA). [1989]. 169p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC04-76DP00789. (CONF-8908123–1-Vugraphs: Severe accident management workshop, 9 Aug 1989). Order Number DE89016368/JAW. Available from NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

The Nuclear Engineering Department of National Tsing Hua University organized a workshop on Severe Accident Management. The workshop was sponsored by Taiwan Power Company and was held at Taipei, Taiwan from July 31 to August 11, 1989. The topics covered in the workshop included the general in-vessel LWR severe accident phenomena, containment responses and performances under severe accident conditions, results of Level 1 PRAs of three Nuclear Power Plants at Taiwan, and also two lectures related to the NUREG-1150 report just published by US NRC. This presentation covers these two lectures.

45155 (WHC-SP–0017-1) **Failure of N Reactor fuel under high-temperature accident simulations.** Birney, K.R. Westinghouse Hanford Co., Richland, WA (USA). Mar 1988. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-87RL10930. Order Number DE89015202/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Fuel-failure data derived from experiments on N Reactor fuel have been developed. The fuel-failure temperature as a function of burnup is determined and a correlation for use in subsequent deterministic analyses of N Reactor core behavior during postulated high-temperature severe accidents is presented. 6 refs., 4 figs., 3 tabs.

45156 Review of pressurized-water-reactor-related thermal shock studies. Cheverton, R.D. (Oak Ridge National Lab., Oak Ridge, TN (US)); Iskander, S.K.; Ball, D.G. pp. 939 of Fracture mechanics. Cruse, T.A. ASTM, Philadelphia, PA (1988). (CONF-860675–: 19. national symposium on fracture mechanics (ASTM), 30 Jun - 2 jul 1986).

Flaw behavior trends associated with pressurized thermal shock (PTS) loading of pressurized water reactor (PWR) pressure vessels have been under investigation at Oak Ridge National Laboratory (ORNL) for approximately twelve years. During that time, eight thermal shock experiments with thick-walled steel cylinders were conducted as a part of the investigations. These experiments demonstrated, in good agreement with linear elastic fracture mechanics (LEFM), crack initiation and arrest, a series of initiation/arrest events with deep penetration of the wall, long crack jumps without significant dynamic effects at arrest, arrest in a rising stress-intensity-factor (K_I) field, extensive surface extension of an initially short and shallow flaw, and warm prestressing with $K_I \leq 0$. This information was used in the development of a fracture mechanics model that is being used extensively in the evaluation of the PTS issue.

45157 Mobile robot for power plant inspection and maintenance. White, J.R.; Farnstrom, K.A.; Harvey, H.W.; Upton, R.G.; Walker, K.L. *Transactions of the American Nuclear Society (USA),* 57: 329-330 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

An all-terrain, mobile robot (called SURBOT-T) has been developed to perform remote visual, sound, and radiation surveillance within contaminated areas of nuclear power plants. The robot can be equipped with a two-armed, telerobotic manipulator system to perform remote maintenance work. The SURBOT-T vehicle has a double-articulating track base that is capable of climbing 45-deg slopes and stairs and over 16-in.-high obstacles. The overall size of SURBOT-T is 28 in. wide by 38 in. long with the front and rear tracks raised and 52 in. high with the camera lowered. With the tracks in a level position, the base provides a sturdy work platform and can ascend/descend stairs without fear of tipping over. The track can be pivoted straight down to elevate the base 14 in. and pass through water up to 24 in. deep. All motors, amplifiers, computer boards, and other electronic components are contained within a sealed housing. The color television camera, spotlight, and directional microphone are mounted on a pan/tilt, which is attached to an elevating mechanism that has 8 ft of vertical travel. An air sampler, radiation detector, and temperature/humidity probe are mounted on the vehicle. The slave manipulator arms on the vehicle can be teleoperated using master arms that are attached to a portable stand near the control console. They can also be taught to perform motions or tasks by computer control much like robot arms in the automated manufacturing industry.

45158 Hot fuel examination facility-north fuel element puncturing and gas sampling system. Wisner, R.S. (Argonne National Lab., IL (USA)). *Transactions of the American Nuclear Society (USA),* 57: 336-337 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

A remotely operated laser fuel element gas-sampling system has been put into service at the Hot Fuel Examination Facility (HFEF) North. This system provides the ability to puncture the cladding of a capsule or fuel element in its plenum region to measure its free volume and pressure and to gather gas samples for composition and isotopic analyses. The element is punctured and pressure data are taken with which to calculate the element's prepuncture internal pressure. After a gas sample is taken, the plenum is evacuated and then back-filled from known calibrated volumes to determine its free volume. The element or capsule may then be repressurized with any specified gas and the cladding puncture rewelded. Although

these welds are primarily for radioactive contamination control of the element and the hot cell and are not qualified for fuel element in-reactor service, the welds that have been made are well characterized and have been tested to 6.89 x 10^5 Pa (100 psia).

45159 Remote retrieval of irradiated EBR-II fuel from in-ground storage silos. Bacca, J.P. (Argonne National Lab., Idaho Falls, ID (USA)); Wisner, R.S.; Vaughn, M.E.; Taylor, D.S. *Transactions of the American Nuclear Society (USA),* 57: 341-342 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Over a number of years, irradiated, depleted-uranium, blanket fuel subassemblies were removed from the Experimental Breeder Reactor II (EBR-II) core, remotely handled in the Hot Fuel Examination Facility/South (HFEF/S) and placed in interim storage in sealed, in-ground storage silos at the Radioactive Scrap and Waste Facility (RSWF) located at the Argonne National Laboratory-West (ANL-W) site of the Idaho National Engineering Laboratory. A total of 343 highly radioactive EBR-II depleted uranium blanket subassemblies and some 252 individual blanket fuel rods were safely, effectively, and efficiently retrieved from their interim in-ground storage silos at the ANL-W site, temporarily stored, and then packaged into shipping casks using the HFEF/S hot cell facilities, and safely shipped to other hot cell facilities for further remote handling and processing.

45160 Analysis of the MSIV closure ATWS in a BWR/6. Pan, Chin; Chen, Genshun; Hsiue, J.K.; Liaw, T.J. *Transactions of the American Nuclear Society (USA),* 57: 351-352 (1988). (CONF-881011–: Joint meeting of the European Nuclear Society and the American Nuclear Society, 30 Oct - 4 nov 1988).

Anticipated transient without scram (ATWS) has received much attention since the beginning of the last decade. It has been recognized as a dominant accident sequence for possible core melt and containment damage in a boiling water reactor (BWR) power plant. In the literature, a great deal of study has been reported on the investigation of BWR behavior during an ATWS, especially for BWR/2 and BWR/4. The objective of this study is to assess reactor behavior during a main steam isolation valve (MSIV) closure ATWS for the Kuosheng nuclear power plant of Taiwan Power Company, which has two units of BWR/6 with Mark-III containment. The analyses were performed using RETRAN-02/MOD3, which solves a one-dimensional homogeneous equilibrium model of two-phase mixture. The relative motion between two phases is treated by the dynamic slip model. Due to the unavailability of appropriate three-dimensional neutronic codes, such as SIMULATE-E, in this country, the option of point kinetics has been adopted for calculations. This approach is not expected to give the exact power shape variation during the transient, but is believed to be appropriate for providing the accurate overall power level, which is the major concern for core and containment integrity.

45161 Rail assembly for use in a radioactive environment. Watts, R.E. To Dept. of Energy, Washington, DC. USA Patent 4,825,769. 2 May 1989. Filed date 29 Jul 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

An improved rail assembly and method of construction thereof is disclosed herein that is particularly adapted for use with a crane trolley in a hot cell environment which is exposed to airborne and liquidborne radioactive contaminants. The rail assembly is generally comprised of a support wall having an elongated, rail-housing recess having a floor, side wall and ceiling. The floor of the recess is defined at least in party by the load-bearing surface of a rail, and is substantially flat, level and crevice-free to facilitate the drainage of liquids out of the recess. The ceiling of the recess overhangs and thereby captures trolley wheels within the recess to prevent them from becoming dislodged from the recess during a seismic disturbance. Finally, the interior of the recess includes a power track having a slot for receiving a sliding electrical connector from the crane trolley. The power track is mounted in an upper corner of the recess with its connector-receiving groove oriented downwardly to facilitate the drainage of liquidborne contaminants and to discourage the collection of airborne contaminants within the track.

25 ENERGY STORAGE

2506 Thermal

Refer also to citation(s) 44946

45162 (SAND–89-0252C) **Pyrotechnic ignition studies using a gun tunnel.** Evans, N.A. Sandia National Labs., Albuquerque, NM (USA). [1989]. 11p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-8909113–1: 14. international pyrotechnics seminar, 18-22 Sep 1989). Order Number DE89012496/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A gun tunnel is being used to investigate the ignition characteristics of center-hole iron/potassium perchlorate thermal battery discs. Details are given of the construction, operation, and data reduction method for the gun tunnel. To simulate an igniter, this system can readily produce a pulse of hot argon at maximum pressures and temperatures up to P_{max} = 8 MPa and T_{max} = 4000K, respectively, with flow times of the order of 3 msec. For a single battery disc, a segment of the ignition boundary was found to lie in the region of T_{max} = 1200 to 1300K and 0.7 MPa < P_{max} < 2.0 MPa. The results also showed two types of ignition: prompt ignition, requiring an average delivered enthalpy $\overline{\Delta H}_{ig}$ = 6 cal during an average flow time $\overline{\Delta t}_{ig}$ = 0.7 msec, and delayed ignition, with $\overline{\Delta H}_{ig}$ = 16 cal and $\overline{\Delta t}_{ig}$ = 2.4 msec. In addition, near an ignition boundary, high speed motion photography showed the ignition delay increased to 6 msec with significant spatial non-uniformity. 1 ref., 6 figs.

2508 Chemical

45163 (N–89-22982) **Space Electrochemical Research and Technology Conference: Abstracts.** National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 49p. (NASA-CP–10029;E–4708;NAS–1.55:10029;CONF-8904196–: 2. space electrochemical research and technology conference, 11-13 Apr 1989). Available from NTIS, PC A03/MF A01.

The objectives of the conference were to examine current technologies, research efforts, and advanced ideas, and to identify technical barriers which affect the advancement of electrochemical energy storage systems for space applications. Papers were presented and workshops were conducted in four technical areas: advanced concepts, hydrogen-oxygen fuel cells and electrolyzers, the nickel electrode, and advanced rechargeable batteries.

2509 Batteries

Refer also to citation(s) 45444

45164 (N–89-22710) **Lightweight fibrous nickel electrodes for nickel-hydrogen batteries.** Britton, D.L. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 10p. (NASA-TM–101997;E–4701;NAS–1.15:101997;CONF-890160–: 4. annual battery conference on applications and advances, 17-19 Jan 1989). Available from NTIS, PC A02/MF A01.

The NASA Lewis Research Center is currently developing nickel electrodes for nickel-hydrogen batteries. These electrodes are lighter in weight and have higher energy densities than the heavier state-of-the-art sintered nickel electrodes. Lightweight fibrous materials or plaques are used as conductive supports for the nickel hydroxide active material. These materials are commercial products that are fabricated into nickel electrodes by electrochemically impregnating them with active material. Evaluation is performed in half cells structured in the bipolar configuration. Initial performance tests include capacity measurements at five discharge levels, C/2, 1.0C, 1.37C, 2.0C, and 2.74C. The electrodes that pass the initial tests are life cycle-tested in a low Earth orbit regime at 80 percent depth of discharge.

45165 (PB–89-866289/XAB) **Lithium batteries. November 1981-July 1989 (Citations from the NTIS data base). Report for November 1981-July 1989.** National Technical Information Service,

Springfield, VA (USA). Jul 1989. 158p. Available from NTISPC N01/MF N01.

Supersedes PB–88-867262.

This bibliography contains citations concerning design, development, components, testing, electrolytes, and safety aspects of lithium cells. Applications include use in electric vehicles, and utility-load-leveling operations. Lithium-chloride and lithium-sulfur batteries are among the types discussed. (This updated bibliography contains 306 citations, 14 of which are new entries to the previous edition.)

45166 (PNL-SA–17038) **Projected costs for sodium-sulfur electric vehicle batteries.** Quinn, J.E.; Symons, P.C.; Brown, D.R.; Riley, D.J.; Atherton, G.; Rampton, S.C. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 15p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-890815–24: 24. intersociety energy conversion engineering conference, 6-11 Aug 1989). Order Number DE89016825/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Cost projections and required selling prices for electric vehicle batteries using sodium-sulfur technology have been developed. The projected costs were aggregated from a unit operations level cost analysis performed by a Chloride Group and Chloride Silent Power, Ltd. team. Designs and costs were based on a 69-kWh battery (nominal capacity) and a manufacturing facility producing 6600 batteries per year. The required selling price was estimated to be $112 per kWh. Sensitivities of cost to larger production volumes were also investigated. In addition, an independent team reviewed the work and found the methodology and results consistent with good cost analysis practice. 1 ref., 5 tabs.

45167 (SAND–89-0700C) **Preparation and evaluation of composite membranes for zinc/bromine storage batteries.** Arnold, C. Jr.; Assink, R.A. Sandia National Labs., Albuquerque, NM (USA). [1989]. 12p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890902–2: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89009931/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Low coulombic efficiencies of zinc/bromine redox batteries have been attributed to migration of bromine and negatively charged bromine moieties through the microporous separator used to separate the catholyte from the anolyte. While it has been demonstrated that improvements in coulombic efficiency can be achieved by replacing the microporous separator with a cationic ion exchange membrane, these membranes are expensive and/or not sufficiently conductive to be practicable. We have found that the rate of bromine permeation can be reduced by two orders of magnitude with minimal decreases in conductivity by impregnating commercial microporous polyethylene type separators with sulfonated polysulfone, a cationic polyelectrolyte that was developed in earlier work for other redox storage batteries. 5 refs., 1 fig., 1 tab.

29 ENERGY PLANNING AND POLICY

45168 (GRS–69, pp. 5-14) **Energy: An endless story. The history of the energy issue and changing scenarios.** Stuermer, M. (Stiftung Wissenschaft und Politik/Forschungsinstitut fuer Internationale Politik und Sicherheit, Ebenhausen (Germany, F.R.)). Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Koeln (Germany, F.R.). May 1989. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). In *Research for enhancing reactor safety*. Order Number DE89914983/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Two oil crises and the reactor accident at Chernobyl have had a profound effect on the population in the USSR and its awareness of environmental issues and hazards. The contribution explains the energy policy and scenarios and the changes undergone in the USSR, the COMECON countries, in the Middle East and in the Persian Gulf, in the Pacific Ocean area, in the North Sea area, and in the USA, also pointing out consequences for the current situation. (DG).

45169 (INIS-mf–11983) **Energy: The endless story. The energy issue in the course of history.** Stuermer, M. Gesellschaft fuer Reaktorsicherheit m.b.H. (GRS), Garching (Germany, F.R.). 1988. 20p. (In German). (CONF-881131–: Society for Reactor Safety meeting on research to increase the safety of nuclear power plants, 3-4 Nov 1988). Order Number DE89910817/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The historian reports on scenarios of energy policy, beginning with the present situation in the USSR, of which the Yom-Kippur War, the Ayatollah's revolution and the reactor accident of Chernobyl were particular determinants. The report sketches out energy-policy scenarios of the past and their consequences for the present as well as outlines of an agenda for the future. Questions regarding nuclear energy and the security of civil nuclear plants have not been considered. (DG).

2901 Energy Analysis and Modeling

Refer also to citation(s) 45390

45170 (CEA/RD–515U528) **Assessment of the energy use in the traditional ceramic industry in Canada.** Reesor, R.; Murthy, M.K.; Mayer, P. Canadian Electrical Association, Montreal, PQ (Canada). 1986. 145p. (CE–02733). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The purpose of this study is to determine the potential for utilization of electro-technologies within the Canadian traditional ceramic industry. The industry was divided into six sectors: glass, structural clay, whiteware and pottery, enamel, abrasives and refractories, and industrial ceramics. A market for potential applications of electrical energy has been identified in specific sectors. The potential for electrification ranges from very little in industries mass-producing low value products, to very high for the sectors which are demanding increased productivity and quality control. There are, however, barriers to be overcome including capital investment in existing facilites and demand for relatively short payback periods. Due to the competitive nature of several industry sectors, the energy use in these industries was claimed as proprietory information, making energy consumption data very difficult to find. Wherever possible, present energy consumption data was estimated by calculation. Updated statistics in many of these industries were not available and questionnaire replies, although often incomplete, were the sole source of information. Relative projections for future energy consumptions were made from future expected market growth. Changes in energy consumption in traditional ceramic industries rely extensively on advances made by furnace manufacturers and developments in advanced ceramic processing techniques. 20 refs., 13 figs., 24 tabs.

45171 (DOE/IG–0269) **Audit of energy research telecommunications data networks.** USDOE Office of Inspector General, Washington, DC (USA). Capital Regional Office. 20 Jul 1989. 8p. Sponsored by U.S. DOE Management & Administration. Available from OSTI.

Report to The Secretary.

The Department of Energy's (DOE) Office of Energy Research is implementing a new telecommunications data network called the Energy Sciences Network (ESNET). The purpose of our audit was to determine if ESNET will be a cost-effective means of upgrading networking support for Energy Research programs.

45172 (ESC-WR–89-14) **The TE-POT-model. The effects of an incentives policy and low fuel prices on small scale cogeneration potential.** Verhagen, L. Stichting Energieonderzoek Centrum Nederland, Petten (Netherlands). Energie Studie Centrum. Jul 1989. 73p. (In (In Dutch)). Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

In order to be able to estimate the contribution of small scale cogeneration (Total Energy) to the future power generation capacity in the Netherlands, a model has been developed which calculates the potential of small scale cogeneration in different sectors. This model, called TE-POT, has been written in Symphony and uses a methodology similar to that used in large scale cogeneration

forecasting. Calculation results are presented for different price scenarios coupled to different types of government energy policies. Calculations have been done for the years 2000 and 2010. It is concluded, on basis of these calculations, that the difference in price between natural gas and electric power, which is decisive for the composition of the public power generation structure, is an important factor for the total operational TE-capacity. 6 refs., 3 apps.

2902 Economics and Sociology

Refer also to citation(s) 45197, 45202, 45203, 45204, 45205, 45222, 45223, 45225, 45284, 45285, 45294, 45296, 45297

45173 (CANWEC–1989) **Energy in western Canada. The potential, the markets and the money.** Canadian National Committee, World Energy Conference, Ottawa, ON (Canada). [1989]. 152p. (CONF-8811238–: 11. Canadian national energy forum, 21-22 Nov 1988; CE–02686). Available from Canadian National Committee World Energy Conference, Suite 305, 130 Albert Street, Ottawa, Ont., CAN K1P 5G4; $30.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

These proceedings present a series of papers and discussions on the ways and means to encourage optimum development of western Canada's energy resources, complementing the 1987 Forum which dealt with eastern Canada's energy opportunities particularly in the Atlantic provinces. Coverage includes provincial energy potential and policies; the future of natural gas; the market for Western Canadian coal; markets for Canadian crude oil; generation, transmission and markets for western Canadian electricity; and Canadian and overseas financing for projects. Short biographies of the speakers are also included. Separate abstracts were prepared for 14 of the papers.

45174 (GRS–667) **How to succeed in the energy market?. A report from a preliminary project.** Borg, A.; Jervan, H. Gruppen for Ressursstudier, Oslo (Norway). Nov 1986. 94p. (In Norwegian). Order Number DE89914752/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report gives a survey of how public authorities have been occupied with developing new energy technologies and of production and trade with energy technological equipment in the Nordic countries. The report deals briefly with various technologies and energy markets. There is a section on various aspects of procedures from research to marketing both in public and private sector in the Nordic countries i.e. economy, research effort in various energy and related sectors. A proposal for a main project is included. There are 7 appendices containing information on energy technological equipment, their share of the foreign trade, import and export values and trade within the Nordic countries. 3 figures, 31 tables.

45175 (KTM/E-D–171) **On the connections and impacts of community energy management.** Itkonen, L. Kauppa- ja Teollisuusministerio, Helsinki (Finland). Energiaosasto. May 1989. 125p. (In Finnish). Order Number DE89787741/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

This study outlines the methods used for assessing energy technology and the impacts it has on physical and social environment. The emphasis is on the social impact assessment (SIA). The study describes how to connect sociological methods and theoretical framework to energy studies. Empirical part of the study concentrates on the energy management in the city of Kuopio. Interviews were made in four other municipalities, too. The research is based mainly on interviews of energy experts and decision or policy makers. The conclusions are presented as an outline of the main connections of community energy management. The analysis shows that the key issues rise from the practise of policy making, planning an decision making. Interactions or cumulative impacts these can have are usually not considered. Local citizens - and local decision makers and consumers, too - often lack information and/or possibilities to take part in the decision making process. By applying methods used for social impact assessment it would be possible to identify and evaluate both the direct and indirect impacts, and also define measures to mitigate negative impacts.

45176 (NBNRE–8810, pp. 12) **The socio-economic impact of wood energy use in the province of New Brunswick.** High, C.J. (Resource Systems Group). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In areas such as New Brunswick, where the forest resource is important to the economy, the effects of wood energy use on the economy and on the forest resource base has been widely recognized. In comparison with the use of oil or coal from outside the province, wood fuels create more jobs and income in New Brunswick; they also assist the improvement of the province's timberlands and facilitate additional harvesting of forest products in otherwise economically unpromising locations. The paper discusses the socio-economic impacts of wood energy use according to a methodology which takes into account the displacement of other fuels by wood, job and income multipliers and a wood energy economic impact spreadsheet model. As an example, a 25 MW wood-fired electric power plant would generate, in New Brunswick, 252 jobs and $14.296M revenue compared with 88 jobs and $4.313M or $0.756M revenue for an equal capacity of 25 MW in a 400 MW power plant fired with coal from New Brunswick or with imported coal. A comparison is also made with the benefits of wood energy in Northern New England states. Overall, the studies completed in New Brunswick to date confirm the widely held view that wood energy has substantial beneficial income and employment impacts in the province. 3 refs., 1 figs., 3 tabs.

45177 (PNL–6942) **Hanford cultural resources management plan.** Chatters, J.C. (ed.). Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 286p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE89015199/JAW. Available from NTIS, PC A13/MF A01 - OSTI; GPO Dep.

As a federal agency, the US Department of Energy (DOE) has been directed by Congress and the President to provide leadership in the preservation of prehistoric, historical, and cultural resources on lands it administers, to manage these in a spirit of stewardship for future generations, and to protect and preserve the rights of Native Americans to religious freedom. The purpose of this document is to describe how the DOE-Richland Operations (DOE-RL) will meet those responsibilities on the Hanford Site, pursuant to guidelines for Agency Responsibilities under the Historic Preservation Act (FR 53:31, February 17, 1988). This document is intended for multiple uses. Among other things, the text is designed as a manual for cultural resource managers to follow and as an explanation of the process of cultural resource regulatory compliance for the DOE-RL and Site contractors. 10 refs., 17 figs., 11 tabs.

2903 Environment, Health, and Safety

Refer also to citation(s) 44464, 44701, 44712, 44714, 44716, 44766, 44792, 44793, 44795, 44796, 44797, 44799, 44826, 45137, 45207, 45304, 45379, 45417, 45418, 45425, 45426, 46079, 46092, 46097, 46103, 46138, 46139, 46153, 46174, 46187, 46188

45178 (CONF-881054–Vol.2, pp. 661-672) **Communication as dialogue.** Bradbury, J.A. (Science Applications International Corp. (USA)); Sigmon, E.B. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

This paper presents an approach in which communication is viewed as dialogue; in this view, communication and public involvement are synonymous. The authors draw upon recent communication theory to illustrate the difference between two models of the communication process and their implications for practice. Examples from a variety of policy areas of the application of communication as dialogue are presented.

45179 (CONF-881054–Vol.2, pp. 673-684) **Meeting the SARA 104 (k) requirement.** English, M.R. (Univ. of Tennessee, Knoxville (USA)). Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

Can Tennessee meet the SARA 104(k) requirement? This paper does not conclusively answer that question. Instead, it focuses on one component of Tennessee's response to SARA: a process for siting hazardous waste facilities. By examining other states' siting processes, the paper investigates a possible institutional framework for siting hazardous waste facilities in Tennessee. It builds on work that the author has previously done on siting processes at the UTK Waste Management Institute and on work that she is currently doing under contract with the TN Department of Health and Environment. Negotiated approaches are emphasized, but others are considered as well.

45180 (CONF-8810239–Absts., pp. 1.1) **DOE environmental compliance policy perspectives and priorities.** Tseng, J. (Department of Energy, Washington, DC (USA)). USDOE Assistant Secretary for Nuclear Energy, Washington, DC (USA). Office of Remedial Action and Waste Technology. 1988. From Remedial action program annual meeting; 18-20 Oct 1988. In *Remedial Action Programs annual meeting. Proceedings.* Order Number DE89009669/JAW. Available from NTIS, PC A24/MF A01.

Over the last several years, the DOE has increasingly come under attack regarding its compliance with various environmental statutes, particularly the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). Recent Congressional hearings have emphasized that DOE must become more proactive in environmental areas and that the Department's national security mission and budget constraints can no longer be used as a shield against environmental compliance. In 1985, Secretary Herrington issued a policy statement concerning DOE's environmental program which emphasized the following points: As a matter of public trust, the Department considers it an obligation to conduct its operations in a safe and environmentally sound manner; DOE activities will be in compliance with both the letter and spirit of the environmental statutes; DOE will minimize risk to the environment through good environmental management practices; and DOE expects its operating contractors to share in the Department's commitment to good environmental management and to conduct their operations in an environmentally sound manner. Several initiatives have been launched to help the Department meet these goals. Efforts to prioritize environmental problems for resolution are underway through DOE's nearly completed environmental survey program.

45181 (EC–8805) **Enforcement and Compliance policy.** Environment Canada, Ottawa, ON (Canada). 1988. 89p. (CE–02656). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This document establishes principles for fair and consistent enforcement of the Canadian Environmental Protection Act, presents guidelines for governments, industry, organized labor, and individuals on what is expected of them, and guides the conduct of Environment Canada and the officials who enforce the Act and its regulations. The policy was developed in cooperation with the Dept. of Justice and will be reviewed within two years of its implementation to determine the need for amendments. The document covers the guiding principles governing the application of the Act, provides definitions of enforcement and compliance, presents the key elements and the context of the Act, with its relationship to the Dept. of National Health and Welfare, describes the authorities responsible for the implementation of the Act, and sets out measures to promote compliance and methods of compliance monitoring, inspection, and investigation, and responses to violations.

45182 (GRS–589) **Social consequences from various energy technologies. Evaluation procedures.** Stenseth, Aa. Gruppen for Ressursstudier, Oslo (Norway). Oct 1984. 170p. (In Norwegian). Order Number DE89914757/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The report is a manual comprising an application-required evaluation procedure designed for assessing the social consequences from the various energy technologies. The manual is a basis designed for the development and systematization of the evaluation methods for each of the technologies. The quantitative and qualitative evaluations in the procedure consists of a sequence of processes. The aim of the procedure is to evaluate the potentiality of the technological impacts on the employment, industrial possibilities, and pattern of settlement. 4 figures, 12 tables, 11 references.

45183 (PB–89-192520/XAB) **Occurrence of synthetic volatile organic chemicals in drinking water, food, and air (revised draft), July 1987.** Environmental Protection Agency, Washington, DC (USA). Office of Drinking Water. Jul 1987. 175p. Available from NTIS, PC A08/MF A01.

The report presents information on the occurrence of Volatile Organic Contaminants (VOC's) in public drinking water supplies, food, and ambient air in the United States and an estimate of human intake of VOC's from those sources. Federal survey data on VOC's levels in the drinking-water systems were combined and stratified according to water source (surface and ground) and size based on population served. These data were used to project a national profile of VOC levels in drinking water that yields estimates of the number of systems of each source/size category, and the total population served by them, at each exposure level.

45184 (PB–89-203780/XAB) **Effluent fees: policy considerations on a source of revenue for infrastructure financing. Technical report.** Casey, P. Yale Univ., New Haven, CT (USA). School of Forestry and Environmental Studies. 1988. 37p. Available from NTIS, PC A03/MF A01.

This project is part of the National Network for Environmental Management Studies conducted under the auspices of the Office of Cooperative Environmental Management - U.S. Environmental Protection Agency. With the phasing out of EPA's construction grants program and the implementation of State Revolving Funds (SRF's), it appears that more money will be needed for the financing of waste-water treatment facilities in the next twenty years. Infrastructure needs for waste-water treatment facilities will increase significantly due to required replacement and upgrading needs, while user fees may be significantly understated due to years of capital subsidies. With Federal seed capital for the SRF's stopping after 1994, alternative sources of funding will be necessary. An effluent fee program could both offer a way to make the polluter pay and provide a reliable financing mechanism for the SRF's. The paper discusses the experience of effluent fees in Europe, and proposes an effluent fee program that would provide needed capital to the State Revolving Fund. The fee would be tied into the National Pollutant Discharge Elimination System permits through gradual implementation. Various options for setting the fee and enforcement procedures are also discussed.

45185 (SF–8903) **Protecting our environment, March 1989.** Saskatchewan Finance, Regina, SK (Canada). 1989. 11p. (MICROLOG–89-02716). Available from Saskatchewan Legislative Library, Government Publications, 234 Legislative Bldgs., Regina, SK, CAN S4S 0B3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This budget document provides the details of new initiatives taken by the provincial government of Saskatchewan in the area of environmental protection. These initiatives include the management of such hazardous wastes as polychlorinated biphenys, agricultural chemicals, and leaded fuel, handling and disposal, and recycling of cans, bottles, and newspapers via a blue box program; protecting water quality by implementing a water management system, the initiation of water and sewage projects, and further research into the effects of agricultural chemicals; the planting of seedlings in the forests and consolidation of natural ecosystem data inventories,as well as environmental conservation activities in connection with the Rafferty-Alameda Dam, soil conservation, the greenhouse effect, and pest eradication; and the establishment of a consultation group to develop a provincial conservation strategy and an environmentally sound approach to economic development in the province. 1 tab.

2904 Natural Resources

Refer also to citation(s) 44901, 45221, 46180

2905 Research, Development, Demonstration, and Commercialization

Refer also to citation(s) 44424, 44464, 44951, 44952, 44954, 45210, 45235, 45305, 45375, 45376, 45398

45186 (DOE/CE–0260-Draft) **Five year research plan: 1989–1993: Solar buildings for a better America: Draft.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of Solar Heat Technologies. Apr 1989. 50p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE89016066/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Since the early 1970's the US Department of Energy and its predecessor, Federal energy organizations have supported the development of solar applications for buildings. In the early years of the Federal Program, the emphasis was on wide-scale demonstrations that were intended to rapidly bring solar heating and cooling technology to the market place. The demonstrations were supported by parallel research efforts involving universities, the national laboratories, and individual companies. Much was learned from these efforts, not the least of which was the difficulty in moving from a demonstration of technical feasibility to a practical, cost effective product in a short time period. The "lessons-learned" from these experiences provided a strong foundation for the program as it shifted from the "demonstration era" to an era that focused almost exclusively on high-risk, high-payoff R&D beginning in the early 1980's. The current program, as described in this document, continues the emphasis on long-term R&D, but also provides support to activities required by the industry in the near-term. It recognizes the increased importance of cooperative efforts with industry, not only as a means of stretching limited program funds, but as an integral component of technology transfer.

45187 (DOE/ER–0415) **Energy Materials Coordinating Committee (EMaCC): Annual technical report, fiscal year 1988.** USDOE Office of Energy Research, Washington, DC (USA). Materials Sciences Div. 30 Jun 1989. 573p. Sponsored by U.S. DOE Energy Research. Order Number DE89015180/JAW. Available from NTIS, PC A25/MF A01 - OSTI; GPO Dep.

The DOE Energy Materials Coordinating Committee (EMaCC) serves primarily to enhance coordination among the Department's materials programs and to further the effective use of materials expertise within the Department. These functions are accomplished through the exchange of budgetary and planning information among program managers and through technical meetings/workshops on selected topics involving both DOE and major contractors. Four topical subcommittees are established and are continuing their own programs: Structural Ceramics, Batteries and Fuel Cells, Radioactive Waste Containment, and Superconductivity (established in FY 1987). In addition, the EMaCC aids in obtaining materials-related inputs for both intra- and interagency compilations. Membership in the EMaCC is open to any Department organizational unit; participants are appointed by Division or Office Directors. The current active membership is listed on the following four pages. The EMaCC reports to the Director of the Office of Energy Research in his capacity as overseer of the technical programs of the Department. This annual technical report is mandated by the EMaCC terms of reference. This report summarizes EMaCC activities for FY 1988 and describes the materials research programs of various offices and divisions within the Department.

45188 (DOE/METC–89/6104) **Technology transfer at the Morgantown Energy Technology Center: FY 88 program report.** Brown, W.A.; Lessing, K.B. USDOE Morgantown Energy Technology Center, WV (USA). Jan 1989. 104p. Sponsored by U.S. DOE Fossil Energy. Order Number DE89000949/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The mission of the Fossil Energy program is to enhance the use of the nation's fossil energy resources. This includes developing technologies to use coal in an environmentally acceptable manner, to extend the reserve base of natural gas and oil, and to develop economically and environmentally improved techniques for extracting energy from oil shales and tar sand. METC's mission applies to certain technologies within this broad scope of technologies encompassed by the Office of Fossil Energy. The Government functions as an underwriter of risk and as a catalyst to stimulate the development of technologies and technical information that might otherwise proceed at a slower pace because of the high-risk nature of the research involved. The research programs and priorities are industry driven; the purpose is to address the perceived needs of industry such that industry will ultimately bring the technologies to the commercial market. To accomplish the goal of having the private sector commercialize Government-initiated technology, METC must have an effective technology transfer program. As evidenced in this report, METC has an active and effective technology transfer program that is incorporated into all aspects of project planning and execution.

45189 (EC/CPG–8902) **Environment Canada Energy Research and Development Programme 1987-88 annual report.** Environment Canada, Ottawa, ON (Canada). Corporate Planning Group. 1989. 165p. (MICROLOG–89-03873). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report provides a detailed overview of Environment Canada's Energy Research and Development Programme. A comprehensive summary is provided for each Service's resources (notably the Atmospheric Environment Service), including annual reports for individual projects. The resources discussed include those provided by the Panel on Energy R&D (PERD), and those supported by Environment Canada and other governmental and industrial organizations. PERD resources continue to provide a significant portion of the Department's total resources for R&D. These resources therefore play a major role in priority areas of acid rain, toxic chemicals, climate change, and human health and safety while at the same time providing significant benefits to environmentally-sound energy development across Canada. The priority areas for federal energy R&D resources include: alternatives to gasoline (new liquid fuels), increased efficiency of energy use (conservation), new energy sources (fusion, renewables), and new technologies and processes for oil production (Western Basin, Canada Lands). For each project, budgets, contractors, objectives, accomplishments, publications (if any), and recommendations are given. 8 figs., 4 tabs.

45190 (GRS–455) **Comparative study of the Scandinavian measures for energy conservation. Measures, experiences, and measuring problems - results from a pre-project.** Jervan, H.; Raaholt, M.H.; Tank-Nielsen, C. Gruppen for Ressursstudier, Oslo (Norway). Nov 1982. 149p. (In Norwegian). Order Number DE89914762/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The report deals with a pre-project comprising a comparative study of the various energy conservation measures in Scandinavia. The experiences gained from the project and an evaluation of the methods used to measure the profitable results from the measures mentioned, are surveyed. The subsequent steps in the project for the evaluation of the measuring methods are presented. 16 figures, 14 tables, 65 references.

45191 (GRS–644A) **Evaluation of the energy conservation prototype program. Supplementary report : Mapping.** Borg, A.; Vinsand, G.; Wilhite, H. Gruppen for Ressursstudier, Oslo (Norway). Nov 1986. 56p. (In Norwegian). Order Number DE89914759/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This report deals with the energy conservation prototype program in Norway, and presents the results from the mapping used for the evaluation of the program. The various financial-supported and none-supported projects are recorded, and cover eight technology groups. The majority of the projects concern the fields of energy production and heat recovery. The report also discusses the methods of mapping, and the final results from the executed file study and questionnaire inquiries are given. Some of the presented tables are used as a descriptive support for the evaluation done in the main report (GRS–644). 2 figures, 18 tables.

45192 (GRS–679) **Encouraging household energy conservation: Have Nordic incentive strategies been grounded in research results?.** Wilhite, H.; Vareide, K. Gruppen for Ressursstudier, Oslo (Norway). Oct 1986. 53p. Order Number DE89914763/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The report deals with the attitude to the household energy conservation program in Scandinavia, and focuses on the encouraging influence from the incentive strategies being grounded in research results. Following aspects are analyzed in this connection: Definitions and some recent international perspectives on family energy research; a review of Nordic research on family energy - use behaviour and decision making; Nordic incentive strategies: what have they missed through imperfect connections to research results?; conclusions and new directions. In addition, the appendix presents: A tabular listing of Nordic research projects on family energy behaviour and decision making; a brief summary of motives for energy conservation in the Nordic countries; selected bibliography. 3 figures, 5 tables, 94 references.

45193 (GRS–734) **Which way to succeed on the energy markets?. A study of the heat pumps and hydraulic turbines in Scandinavia.** Borg, A.; Lotherington, A.T.; Roeed, M.; Aasen, B. Gruppen for Ressursstudier, Oslo (Norway). Nov 1987. 51p. (In Norwegian). Order Number DE89914760/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The report deals with a project studying the product development and changed market requirements for heat pumps and hydraulic turbines in Scandinavia. The project covers various methods to succeed on the energy market. The aim of this study was to focus on the critical factors existing in this field, and also in which way the industry selects the various break-through strategies. 3 figures.

45194 (NEI-DK–189) **Statement of energy policy 1987. The minister of energy's statement regarding the law on energy policy measures and the law on Danish Oil and Natural Gas.** Energiministeriet, Copenhagen (Denmark). Dec 1987. 19p. (In Danish). Order Number DE89914660/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Since the energy crisis, Denmark has taken many far-reaching initiatives in the field of energy resources and utilization and is now considerably less dependent on fuel imports. The present low price of oil and coal is beneficial to the continue which makes it necessary to set goals for a flexible and varied energy supply. The government looks very positively on the development of renewable energy sources. Future increased investment in oil and natural gas production and supplies will be imperative. Policy regarding energy duties will also be taken up to revision. The Danish government is fully aware of the necessity of environmental protection, and will ensure that investments in this respect will be given priority insofar as it remains in harmony with national energy policy and industrial efficiency. The paper also includes descriptions of the activities of the Danish concerns DANGAS, DOPAS and DORAS which work with oil and natural gas supply. (AB).

45195 (NEI-NO–92) **Energy-directed utilization of refuse.** Soma, M.H.; Kjerschow, E. Kjelforeningen - Norsk Energi, Oslo (Norway). Jun 1988. 43p. (In Norwegian). Order Number DE89914783/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report deals with the various research programs and activities on the utilization of refuse for energy purposes in Norway. The main areas for research and development activities today are in the fields of incineration techniques, flue gas cleaning, environmental research on recipient consequences, and landfill gas extraction and utilization. The main problems have until now been limited district heating systems, low energy prices on alternative energy sources, and public environmental questions. New challenges are electricity production from refuse and biomass energy, and also in the fields of efficient electricity production from refuse and biomass energy, and also development of technologies. 1 fig., 39 refs.

45196 (ORNL–6540/V2) **Energy Division annual progress report for period ending September 30, 1988: Volume 2.** Oak Ridge National Lab., TN (USA). Jun 1989. 257p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015686/JAW. Available from NTIS, PC A12/MF A01; OSTI; INIS; GPO Dep.

The goals and accomplishments of the Energy Division of Oak Ridge National Laboratory are described in this annual progress report for Fiscal Year (FY) 1988. The Energy Division is a multidisciplinary research organization committed to (1) increasing the knowledge and understanding of the way society makes choices in energy use and energy-using technologies, (2) improving society's understanding of the environmental implications of changes in energy technology, and (3) improving and developing new energy-efficient technologies. The Energy Division's programmatic activities focus on four major areas: (1) analysis and assessment, (2) transportation and decision systems research, (3) technology research and development for improving the efficiency of energy and end-use technologies, and (4) electric power systems. The Division's total expenditures in FY 1988 were $44.3 million. The work is supported by the US Department of Energy, US Department of Defense, many other federal agencies, and some private organizations. Disciplines of the 139 staff members include engineering, social sciences, physical and life sciences, and mathematics and statistics.

45197 (ORNL/TM–11155) **The transfer and diffusion of new technologies: A review of the economics literature.** Curlee, T.R.; Goel, R.K. Oak Ridge National Lab., TN (USA). Jun 1989. 54p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015671/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report presents a general overview of the economics literature on technological change and focuses particularly on the interface between the public and private sectors in promoting the transfer and diffusion of new technologies. Our ability to transfer and diffuse new technologies is generally recognized as a key to increased productivity in the United States and this country's ability to compete internationally. A great deal of research has been done on technology transfer and diffusion by various disciplines and from numerous perspectives. Unfortunately, the policy implications of those different works are not always consistent. Further, the different disciplines have difficulty in communicating even when addressing the same issues and drawing the same general conclusions. The primary objective of this report is to lessen the chasm among the disciplines with respect to technology transfer and diffusion by summarizing the perspectives presented in the economics literature. The document is intended primarily for an interdisciplinary audience. 57 refs.

45198 (PB–89-195382/XAB) **National Science Foundation annual report, 1988.** National Science Foundation, Washington, DC (USA). 1988. 58p. (NSF–89-1). Available from NTIS, PC A04.

Also available from Supt. of Docs. See also report for 1987, PB–88-219852.

The 1988 annual report of the National Sciences Foundation is presented.

45199 (STF–15A88037) **Topic seminar HVAC 1988.** Jacobsen, T.; Mathisen, H.M. Selskapet for Industriell og Teknisk Forskning, Trondheim (Norway). Sep 1988. 31p. (In Norwegian). (CONF-8810419–: Topic seminar HVAC '88, 6 Oct 1988). Order Number DE89914785/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The report comprises a collection of papers given at a seminar dealing with the research programs in the fields of solar energy and ventilation in Norway. 5 figs.

45200 (UA–9016436) **SOMED [School of Mines and Energy Development]: Annual report, 1987–1988.** Coulter, L.B. (comp.). Alabama Univ., University, AL (USA). School of Mines and Energy Development. [1989]. 16p. Sponsored by University of Alabama. Order Number DE89016436/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The University of Alabama has an established commitment to assist in the prudent development of the state's natural resources. The State School of Mines, which was established by legislation, was expanded and designated the School of Mines and Energy Development (SOMED) in 1977. SOMED has the functional responsibility for the planning, coordination, and support of mineral and energy related research at the University through the various

schools and colleges, the Natural Resources Center, and the Mineral Resources Institute. SOMED also supports faculty research through a grants program and undergraduate and graduate research and education in scholarships, fellowships, and grants. in the past 12 years, SOMED has been successful in carrying out its mission. SOMED programs are briefly outlined.

45201 (UCRL–53859-88) **Energy Program annual report, 1988.** Borg, I.Y. (ed.). Lawrence Livermore National Lab., CA (USA). Jul 1989. 45p. Sponsored by DOE/CE;DOE/ER;DOE/FE;DOE/NE. DOE Contract W-7405-ENG-48. Order Number DE89016953/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This report is a summary of work done during FY 1988 (October 1, 1987–September 30, 1988) by the Energy Program of the Lawrence Livermore National Laboratory (LLNL). The program addresses problems relating to supply and utilization of energy in the US. Traditionally the focus of activities has been on long-range technical challenges that are unlikely to be pursued by the private sector. Individual projects making up the Energy Program are divided into three sections in this review: Nuclear Energy, Fossil Energy, and Nonfossil Energy. (Nonfossil Energy research includes work on geothermal resources and combustion chemistry.)

2906 Nuclear Energy

Refer also to citation(s) 44714, 44715, 44716, 44725, 45053, 45057, 45229

45202 (AD-A–207729/5/XAB) **Price stabilization in a national security emergency.** Center for Planning and Research, Inc., Palo Alto, CA (USA). Oct 1984. 25p. Available from NTIS, PC A03/MF A01.

The purpose of this document is to provide guidance to State and local government leaders, Federal agency regional staff, and private sector NDERs on price stabilization during a national security emergency following a nuclear attack on the United States. The guidance covers basic authorities, the emergency conditions, planning assumptions, general policies, concept of operations, and the price-stabilization organization and its responsibilities. The document provides the basis for improving the readiness of State and local jurisdictions for undertaking economic stabilization program. The guidance is intended to be sufficiently flexible so that modifications can be made to meet any variations and unique requirements and situations which may prevail in the various States and localities. Under the conditions of severe economic dislocation attendant to a national emergency that results in an attack on the nation, the primary objective of economic stabilization would be to maintain and protect the surviving economy as part of the overall effort directed toward national survival and recovery. Stabilization strategies would be applied to: financial and monetary systems; wages, salaries, and benefits; prices; rents; and rationing of essential goods. These measures are designed to maintain public confidence in market and financial systems and their institutions so that general inflation can be controlled, scarce resources conserved, and the recovery effort supported so that the most-efficient use is made of human material and capital resources to bring about national recovery as rapidly as possible.

45203 (AD-A–207730/3/XAB) **Rationing in a national security emergency.** Center for Planning and Research, Inc., Palo Alto, CA (USA). Oct 1984. 53p. Available from NTIS, PC A04/MF A01.

This guidance document, provides the necessary information to State and local government on their roles in their jurisdictions related to consumer rationing during a national security emergency. The guidance covers the areas of policy, authority, and concept of operations for the emergency conditions of evacuation during a national security emergency and post-attack reconstitution and recovery following a nuclear attack. The document provides the basis for improving the readiness of State and local jurisdictions for undertaking consumer rationing as part of an economic stabilization program. Under the conditions of severe economic dislocation attendant to a national emergency that results in an attack on the nation, the primary objective of economic stabilization would be to maintain and protect the surviving economy as part of the overall effort directed toward national survival and recovery. Stabilization strategies would be applied to: financial and monetary systems; wages, salaries, and benefits; prices; rents; and rationing of essential goods. These measures are designed to maintain public confidence in our market and financial systems and their institutions so that general inflation can be controlled, scarce resources conserved, and the recovery effort supported so that most efficient use is made of human material and capital resources to bring about national recovery as rapidly as possible.

45204 (AD-A–207731/1/XAB) **Money, credit, and banking in a national security emergency.** Center for Planning and Research, Inc., Palo Alto, CA (USA). Oct 1984. 24p. Available from NTIS, PC A03/MF A01.

This guidance document is intended to provide State and local leaders and, through them, the general public and financial institutions and private-sector industries with information on relevant portions of plans for economic stabilization and measures to maintain basic elements of the money, credit, and financial system and provide for its restoration following a major emergency. It discusses general assumptions, objectives, and policies applicable to various emergency conditions and indicates the roles of State and local officials and financial institutions in planning for and operating under such conditions. Earlier guidance has primarily been addressed to an emergency initiated by a major attack on the United States. Revisions of emergency guidance documents have been undertaken to extend coverage to include evacuation of population in the threat of nuclear attack. It also reviews emergency economic actions in other conditions of lesser impact, such as those arising from increasing international tension or mobilization for conventional war. During such conditions Federal nationwide intervention may be required in the U.S. economy through emergency actions to manage resources in furtherance of national goals. At this time, additional economic stabilization measures may become necessary to support emergency resource management. These may include direct as well as indirect controls to combat inflation, panic buying, hoarding, speculation, or other adverse actions; support efficient resource management; and maintain confidence in the monetary and financial system.

45205 (AD-A–207732/9/XAB) **Wage and salary stabilization in a national security emergency.** Center for Planning and Research, Inc., Palo Alto, CA (USA). Oct 1984. 40p. Available from NTIS, PC A03/MF A01.

This guidance document provides the necessary information to State and local government leaders on their roles in their jurisdictions related to wage and salary stabilization (WSS)* during a national security emergency. The guidance covers the areas of policy, authority, and concept of operations for the emergency conditions of evacuation during an intense crisis prior to attack and post-attack recovery following a nuclear attack. The document provides the basis for improving the readiness of State and local jurisdictions for undertaking economic stabilization programs. Under the conditions of severe economic dislocation attendant to a national emergency that results in an attack on our nation, the primary objective of economic stabilization would be to maintain and protect the surviving economy as part of the overall effort directed toward national survival and recovery. Stabilization strategies would be applied to: financial and monetary systems; wages, salaries, and benefits; prices; rents; and rationing of essential goods. These measures are designed to maintain public confidence in the market and financial systems and their institutions so that general inflation can be controlled, scarce resources conserved, and the recovery effort supported so that the most efficient use is made of human material and capital resources to bring about national recovery as rapidly as possible.

45206 (DOE/NE/37961–1) **Examination of the legal mechanisms to regulate advanced fision reactors.** Brinig, M.F.; Repici, D.J. George Mason Univ., Fairfax, VA (USA). School of Law. Dec 1988. 79p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-86NE37961. Order Number DE89016386/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The George Mason University School of Law (GMUSL) located in Northern Virginia, and its subcontractor, The John Francis Company, Inc., of Fairfax, Virginia, conducted a study for the Department of Energy's Office of Nuclear Energy which examined the legal

mechanisms for the regulation of advanced fision reactors. This report presents the research and findings conducted under that study.

45207 (DOE/RW–0043-Rev.3) **Program management system manual: Revision 3.** USDOE Office of Civilian Radioactive Waste Management, Washington, DC (USA). Aug 1989. 138p. Sponsored by U.S. DOE Radioactive Waste Management. Available from OSTI.

OCRWM has developed a program management system (PMS) to assist in organizing, planning, directing and controlling the Civilian Radioactive Waste Management Program. A well defined management system is necessary because: (1) the Program is a complex technical undertaking with a large number of participants, (2) the disposal and storage facilities to be developed by the Program must be licensed by the Nuclear Regulatory Commission (NRC) and hence are subject to rigorous quality assurance (QA) requirements, (3) the legislation mandating the Program creates a dichotomy between demanding schedules of performance and a requirement for close and continuous consultation and cooperation with external entities, (4) the various elements of the Program must be managed as parts of an integrated waste management system, (5) the Program has an estimated total system life cycle cost of over $30 billion, and (6) the Program has a unique fiduciary responsibility to the owners and generators of the nuclear waste for controlling costs and minimizing the user fees paid into the Nuclear Waste Fund. This PMS Manual is designed and structured to facilitate strong, effective Program management by providing policies and requirements for organizing, planning, directing and controlling the major Program functions.

2908 Waste Heat Utilization

Refer also to citation(s) 45210

45208 (EPRI-GS–6380, pp. 11-20) **A utility perspective: Dispatching cogeneration to meet electric system operating requirements.** Nola, S.J. (Southern California Edison Co., Rosemead (USA)); Schapiro, A.R. Electric Power Research Inst., Palo Alto, CA (USA). Jun 1989. (CONF-8706162–: 11. EPRI geothermal conference and workshop: basis for expansion, 23-25 Jun 1987). In *Proceedings: Eleventh EPRI geothermal conference and workshop. Basis for expansion.* Order Number DE89012994/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In October 1980 Edison publically announced its commitment to accelerate the development of renewable and alternative generation resources. At that time, the commitment became the centerpiece of Southern California Edison's future generation resource plan. Edison's cogeneration and alternate renewable commitment have been vigorously pursued, and from today's perspective, has been so successful that it now challenges our ability to continue to provide reliable service at the lowest possible cost. This paper presents a review and update of Southern California Edison's cogeneration and alternate renewable program. It encompasses our goals, achievements and plans for integrating cogeneration and small power projects into our grid. In particular, the need for limited utility dispatching of cogeneration projects is addressed.

2910 Conservation

Refer also to citation(s) 45239, 45240, 45241, 45242, 45243, 45244, 45245, 45246, 45247, 45248, 45249, 45250, 45251, 45252, 45253, 45254, 45255, 45256, 45257, 45258, 45259, 45260, 45261, 45262, 45263, 45264, 45265, 45266, 45267, 45268, 45269, 45270, 45271, 45272, 45273, 45274, 45275, 45276, 45277, 45278, 45279, 45280, 45281, 45345, 45346, 45347, 45348, 45349, 45390, 45431, 45432

45209 (DOE/CE/10509–H2) **Directory of energy efficiency information services for the residential and commercial sectors.** Meridian Corp., Alexandria, VA (USA). 30 Nov 1988. 64p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC01-85CE10509. Order Number DE89016061/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This directory is a compilation of organizations which disseminate a wide range of information on the efficient use of energy in the residential and commercial sectors. Each organization's services are defined by the informations' targeted audience, types of services offered, topics and sectors addressed and access terms required. The organizations included in this directory are based on the Guide to Energy Efficiency Information Services for the Residential and Commercial Sectors, June 1987. The information is presented in two formats in this directory, each focusing on different manners of data retrieval. Section One provides a matrix illustrating the information available by the type of energy-efficiency services offered and Section Two presents information on available services in an alphabetized list by the organization name.

45210 (ENR/SE–1988) **Energy Conservation and Renewable Energy Research, Development and Demonstration Program annual report, 1987/88.** Alberta Energy and Natural Resources, Edmonton, AB (Canada). Scientific and Engineering Services and Research Div. 1988. 28p. (MICROLOG–89-02996). Available from Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, CAN T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The importance of energy conservation and renewable energy to Alberta's overall energy situation continues to be recognized and supported by the Alberta/Canada Energy Resources Research Fund. This support is reflected in the Energy Conservation and Renewable Energy Research, Development and Demonstration Program, which began in 1977 with research projects focusing on solar and wind energy. Since then, research, development and demonstation projects have been supported on such topics as geothermal energy, fusion energy, energy conservation in buildings, waste heat recovery and general energy conservation. Beginning in 1983/84, the program's emphasis shifted to three subjects, each of which became a separate subprogram area. These subprograms are in the areas of energy conservation in buildings, wind energy, and waste heat recovery/low temperature heat utilization. This report reviews the projects undertaken in these three subprograms. In 1987/88, a fourth subprogram dealing with energy conservation in industry was initiated, and a hydrogen technology research program, were initiated. In addition, a technology transfer and dissemination project, begun during the last quarter of 1985/86 to raise the profile of the program continued as a contract service.

45211 (ETDE-mf–9910994) **Residential development planning in new development areas with a view to energy conservation.** Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Aug 1987. 179p. (In German). (890915). Order Number DE89910994/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; NTIS (US Sales Only), PC A09/MF A01.

The meeting was dedicated to the discussion of possible measures and central aims energy conservation in newly erected residential areas should be based on. Five of the papers submitted were dealing with the following subjects: Structural energy conservation measures for newly erected residential areas; energy-saving and environmentally compatible heating systems in newly erected residential areas; legal basis of energy-saving development plans in Hesse; decisions relevant to energy conservation on the different levels of municipal development planning; regional planning requirements of energy-saving development plans (planning aims of the regional planning scheme of South Hesse). The papers are completed by system drawings, basic drawings, tables, and diagrams. Separate records are available for five papers. (HWJ).

45212 (ETDE-mf–9911011, pp. 9-12) **Status of energy consulting services as part of Hessian energy policies.** Zinn, H. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. (In German). In *First meeting of the energy consulting working committee, August 11, 1986. Proceedings.* Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Energy consulting activities aim at eliminating information deficits which, rather than economic inefficiencies, tend to impede the realization of energy conservation measures. A study investigating into the energy conservation potentials of private households in Hesse showed that electric power demands could be reduced by about 58%. The result is indicative of the importance of energy consulting serivces. Municipal and regional services are therefore planned to be offered. (HWJ).

45213 (ETDE-mf–9911011, pp. 13-31) **Energy consulting - demands, requirements, problems.** Feist, W. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. (In German). In *First meeting of the energy consulting working committee, August 11, 1986. Proceedings.* Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Six theses point out energy consulting demands, requirements, and problems. Details are given on problems arising from an excessive energy consumption (e.g. development of prices, environmental impacts, safety, and social problems), possibilities of improving energy utilization (space heating, flow sheet showing the 1982 energy demand of the Federal Republic of Germany), the conditions consistent energy conservation policies depend on (measures, overall concepts, investments), and energy consulting as a central vehicle for the development of energy conservation potentials (drafts, information made available to the public, advanced training, financing). Thesis 5 and 6 refer to energy consulting requirements, the qualification of consulting engineers, and the equipment (offices, computers) to be used. (HWJ).

45214 (ETDE-mf–9911011, pp. 33-41) **The Saarbruecken energy services - experiences reviewed.** Leonhardt, W. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. (In German). In *First meeting of the energy consulting working committee, August 11, 1986. Proceedings.* Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Apart from being engaged in energy conservation and pollution abatement measures (fluidized-bed and cogeneration plants) the Saarbruecken public utilities (water, gas, district heating, electric power, and short-distance traffic) are offering energy services informing users about energy conservation and the thermal insulation of buildings. The services include energy consulting services, information centers, mobile information centers, service check books (heat losses, natural gas, heating systems, analyses with the help of heat cameras), energy conservation programs (questionnaires distributed to households to assess building structures, sites, windows, etc.), financial assistance (thermal retrofitting of buildings), use-and-save services (users who are enabled to directly control energy consumption themselves are willing to save energy), and natural gas bonus services (environmental bonus for the retrofitting of heating systems). (HWJ).

45215 (ETDE-mf–9911011, pp. 43-54) **The Kassel Energy Center - structure and activities of an independent energy consulting institution supported by the city of Kassel.** Flore, C. (Energiezentrum, Kassel (Germany, F.R.)); Eicke, W. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. (In German). In *First meeting of the energy consulting working committee, August 11, 1986. Proceedings.* Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

The Kassel Energy Center informs renters, landlords, building societies, etc. about energy conservation (heating systems and electric power). Details are given on the structure and energy consulting activities of the center, the local conditions of development (50% of all energy demands for space heating purposes), arguments supporting an independent energy consulting center, aims (thermal insulation of buildings, modern space and water heating systems), the discussion of drafted concepts, organization (co-operating partners, finanical assistance on the part of the Hessian Government, committees), consulting premises, teams, and programs, public relations, and the positive experiences and results of the past 1.5 years. (HWJ).

45216 (ETDE-mf–9911011, pp. 55-59) **The Energy Shop - an independent energy consulting institution for the region around Kassel.** Schweer, R. (Energieladen, Kassel (Germany, F.R.)). Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. (In German). In *First meeting of the energy consulting working committee, August 11, 1986. Proceedings.* Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Since 1985, the Kassel region has been profitting by an independent energy shop contributing to the realization of primary energy conservation, pollution abatement, and the protection of consumers, supplying forecastings of long-term developments, and protecting consumers against suboptimum investments. Details are given on the equipment available, the organization, scope, and experiences (actual state analysis and strategic advice, use of computers, elimination of residential health hazards). Emphasis is on renewable energy programs, mobile energy conservation propaganda programs, and municipal energy consulting services (pbulic relations). (HWJ).

45217 (ETDE-mf–9911011, pp. 65-68) **The Grebenau energy consulting project - experiences and practice.** Lohr, H.J. (ENCO GmbH, Kassel (Germany, F.R.)). Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. (In German). In *First meeting of the energy consulting working committee, August 11, 1986. Proceedings.* Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Details are given on a supply concept developed for a community consisting of six local districts (3000 inhabitants). Investigations into different energy sources (fuel oil, coal, liquefied gas, district heating) were followed by the development of a cadastral heat supply survey, energy consulting activities (consultative discussions, on-the-spot data recording), and computer-assisted energy balances (tabular example of a model house). The feasibility study and energy consulting activities showed central heat supplies using internal combustion heat pumps, and district heating systems to be the most efficient and cheapest systems. 30 buildings will be connected to the district heating network (630 kW) in the course of the first stage of the program. (HWJ).

45218 (ETDE-mf–9911011, pp. 83-89) **Energy consulting services for towns, communities, and individuals offered by the district energy agent.** Kraft, H. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jan 1987. (In German). In *First meeting of the energy consulting working committee, August 11, 1986. Proceedings.* Order Number DE89911011/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The district energy agent is required to intervene in fuel oil purchases and natural gas supply contracts (public buildings). He is responsible for the training of janitors, and the implementation of innovative technologies (gas heat pumps, cogeneration plants, straw and wood waste processing plants, practicability of coal-fired systems). Activities include analyses of administrative buildings, swimming pools, gymns, and city halls, boilers (age, efficiency, flue gas temperatures), ventilation ducts, radiators, windows, the thermal insulation of roofs, control systems. Individual energy consulting services include analyses of the efficiency of newly installed boilers, do-it-yourself solar heating systems, the thermal insulation of buildings, and energy conservation schemes for existing buildings. An 'in touch with energy systems' exhibition informed about tile stoves, thermodiesels, and chimney systems. (HWJ).

45219 (GRS–605) **Adventure or necessity?. Decade-periodic experiences with politics for energy conservation in Scandinavia.** Jervan, H.; Raaholt, M.H.; Aasen, B. Gruppen for Ressursstudier, Oslo (Norway). May 1985. 89p. (In Norwegian). Order Number DE89914761/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

This report deals with a project on the evaluation of the experiences with and the effects from the energy conservation policy in the period from 1973 to 1984 in Scandinavia. The emphasis is laid on the energy use owing to the fact that the contribution from the public has been maximised in this field. Following topics are discussed: Policy for energy conservation - a decade-periodic perspective; from occasional action to master plan, results from the means. 13 figures, 9 tables, 41 references.

45220 (PNL–6673) **Economic analysis of proposed voluntary energy conservation standard for new residential buildings.** Marsh, S.J.; Roop, J.M.; Callaway, J.W.; Taylor, Z.T. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 78p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89015623/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The objective of this document is to present an analysis of the impacts of the proposed voluntary energy conservation standard for

the construction of new residential buildings. This analysis examines the impacts of having the proposed residential standard apply immediately and, alternatively, having the proposed standard phased in over a five-year period. It does not address the question of whether realistically the standard would be adopted by states, nor does it weight the improbable impact of states with higher energy efficiency standards modifying their standard to comply with this voluntary standard. 19 refs., 1 fig., 12 tabs.

2920 Supply, Demand, and Forecasting

Refer also to citation(s) 44603, 45173, 45211, 45224, 45231, 45238, 45345, 45346, 45347, 45348, 45349

2930 Policy, Legislation, and Regulation

Refer also to citation(s) 44766, 44768, 45173, 45181, 45185, 45194, 45206, 45297, 46138, 46139

45221 (EF–1988) **Prince Edward Island Dept. of Energy and Forestry annual report, 1987-1988.** Department of Energy and Forestry, Charlottetown, PE (Canada). 1988. 25p. (MICROLOG–89-02776). Available from Prince Edward Island. Dept. of Energy and Forestry, Shaw Bldg., 105 Rochford St., PO Box 2000, Charlottetown, PE, CAN C1A 7N8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report covers the activities of the branches of the Energy and Minerals Branch, and the Forestry Branch. The Energy and Minerals Branch is responsible for energy policy development, monitoring the evaluation of energy alternatives, provision of conservation and alternatives information to the public, maintaining interprovincial and international liaisons, and regulating and encouraging the exploration for minerals and hydrocarbons within the province. The Branch is particularly concerned with development of nonconventional energy sources and ensuring secure supplies of energy, particularly electricity. The Forestry Branch is concerned with maximizing the economic benefits from the province's forest resources, a nonconventional energy source of great potential. Specific objectives include development of a local wood fuel industry, assisting woodlot owners with forest management, and conducting research and development of new technologies for wood processing and production.

45222 (NEB-SS–BT31-2-1988-III-14) **National Energy Board, 1987-88 estimates. Part 3, expenditure plan.** National Energy Board, Ottawa, ON (Canada). 1987. 68p. (In English and French). (MICROLOG–87-02884). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $4.00; OTHER COUNTRIES: $4.80 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The National Energy Board of Canada is responsible for regulating certain energy-related activities within federal jurisdiction, primarily pipelines, international electric power transmission, and energy exports. It also provides advice to the government on energy related issues. This document presents an overview of the Board's program, giving highlights of plans and recent performance, program objectives and effectiveness, and a profile of the program's resources. Budgetary information is detailed for specific parts of the Board's activities. 1 fig., 7 tabs.

45223 (NEB–SSBT31-2-1990-III-14) **National Energy Board, 1989-90 estimates. Part 3, expenditure plan.** National Energy Board, Ottawa, ON (Canada). 1989. 82p. (In English and French). (MICROLOG–89-03584). Available from National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $4.00; OTHER COUNTRIES: $4.80 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The National Energy Board of Canada is responsible for regulating certain energy-related activities within federal jurisdiction, primarily pipelines, international electric power transmission, and energy exports. It also provides advice to the government on energy related issues. This document presents an overview of the Board's program, giving highlights of plans and recent performance, program objectives and effectiveness, and a profile of the program's resources, in the areas of facilities regulation, traffic/tolls/tariffs regulation, export/import regulation, advisory and inquiry activities, and administration. Budgetary information is detailed for specific parts of the Board's activities. 10 figs., 4 tabs.

45224 (NEB–SS-NE1-1988E) **National Energy Board annual report, 1988.** National Energy Board, Ottawa, ON (Canada). 1988. 133p. (MICROLOG–89-03799). Available from National Energy Board, Regulatory Support Office, 473 Albert Street, Ottawa, Ont., CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The National Energy Board is a Canadian federal regulatory tribunal whose powers include the licensing of oil, natural gas, and electricity exports, the certification of interprovincial and international power lines, and the setting of tolls and tariffs for oil and gas pipelines under federal jurisdiction. The Board also keeps under review the Canadian supply of all major energy commodities, with emphasis on electricity, oil, natural gas, and the by-products derived from oil and natural gas, as well as the demand for Canadian energy in Canadian and export markets. The Board also has responsibilities under the Northern Pipeline Act and the Energy Administration Act. This report reviews the year's activities of the Board and also presents a review of energy developments in Canada, such as energy production and consumption, exports, and reserves. As part of the Board's activities, hearings are conducted on various matters and the major decisions, and information on applications to the Board, are summarized. The changes made during the year to the acts, regulations, and rules under which the Board operates are also given. Appendices to the report present various statistical data on oil, gas, electric, and overall energy developments. 23 figs., 33 tabs.

45225 (NPA–BT31-2-1988-III-31) **Northern Pipeline Agency Canada, 1987-88 estimates. Part 3, expenditure plan.** Northern Pipeline Agency, Ottawa, ON (Canada). 1987. 38p. (In English and French). (MICROLOG–87-02901). Available from Northern Pipeline Agency, Lester B. Pearson Building, 125 Sussex Drive, Ottawa, ON, CAN K1A 0G2; $3.00; OTHER COUNTRIES: $3.60 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Northern Pipeline Agency was established to facilitate the efficient and expeditious planning and construction of the Alaska Highway Gas Pipeline in a manner consistent with tthe best interests of Canada as defined in the Northern Pipeline Act. This document presents an overview of the Agency's programs, highlights of plans and recent performance, and a profile of program resources. Detailed budgets for various parts of the program are included. 2 figs., 6 tabs.

2940 Fossil Fuels

Refer also to citation(s) 44407, 44461, 44463, 44506, 44603, 44605, 44606, 46079

45226 (CEC–9016060) **Quarterly oil report: Fourth quarter, 1988.** California Energy Resources Conservation and Development Commission, Sacramento, CA (USA). Mar 1989. 50p. Sponsored by California Energy Commission. (P–300-89-015). Order Number DE89016060/JAW. Available from NTIS, PC A04/MF A01 - OSTI.

This issue contains information and data on the following topics: petroleum fuels market activity, price trends, refining activities, production, and petroleum company financial statements. 10 figs., 6 tabs.

45227 (CONF-8810273–, pp. 3, Paper 13) **Comments on coal and related issues.** Kakizawa, K. Atlantic Council of the United States, Washington, DC (USA). 1989. From US-Japan energy policy consultations meeting; 16-18 Oct 1988. In *US–Japan energy policy consultations.* Order Number DE89003853/JAW. Available from NTIS, PC A 07.

The author's comments are grouped under three topics: (1) current status of world coal trade; (2) future prospects of coal supply and demand; and (3) comments on US coals. It is noted in (1) that

Japan's coal imports (91 million tons in 1987) were more than 25% of the world's total coal trade (341 mt). Also, coal production in China and Colombia have fallen under targets, while production in Australia has been reduced because of labor disputes; supplies from the US and Canada have increased. Coal prices, which had constantly declined since 1981, hit bottom in 1987 and then began to rise again. It is stated in (2) that short- and intermediate-term demand for metallurgical coal is expected to show steady growth; no rapid increase in steam coal is expected in the short term; and growth of coal demand is expected in developing countries, particularly Asian countries other than Japan. Coal-exporting countries are moving toward decreasing production costs. In (3), US coals are regarded as reliable and powerful supply sources, and there are new expectations of supply to Japan at a competitive price equivalent to Australian coals.

45228 (DOE/CE–0269) **The Petroleum Violation Escrow Remote Bulletin Board System: User's guide, Version 1.1.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of State and Local Assistance Programs. Aug 1989. 86p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE89017227/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The Petroleum Violation Escrow Remote Bulletin Board System (PVERBBS) was designed to distribute information on State energy projects, planned or operating. The project entries will be useful to anyone interested in implementing or marketing energy conservation activities or tracking State use of Exxon and Stripper Well overcharge funds. DOE's Office of State and Local Assistance Programs, which monitors State proposals for use of the funds, expects the Bulletin Board to expand public participation in energy efficiency projects. (CBS)

45229 (DOE/EIA–0035(89/04)) **Monthly energy review, April 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. 27 Jul 1989. 136p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE89016553/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Monthly Energy Review presents current data on production, consumption, stocks, imports, exports, and prices of the principal energy commodities in the United States. Also included are data on international production of crude oil, consumption of petroleum products, petroleum stocks, and production of electricity from nuclear-powered facilities.

45230 (DOE/EIA–0109(89/06)) **Petroleum supply monthly.** USDOE Energy Information Administration, Washington, DC (USA). Office of Oil and Gas. Jun 1989. 125p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016736/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

Data presented in this report describe the supply and disposition of petroleum products in the United States and major US geographic regions. The data series describe production, imports and exports, inter-Petroleum Administration for Defense (PAD) District movements, and inventories by the primary suppliers of petroleum products in the United states (50 States and the District of Columbia). The reporting universe includes those petroleum sectors in "Primary Supply". Included are: petroleum refiners, motor gasoline benders, operators of natural gas processing plants and fractionators, inter-PAD transporters, importers, and major inventory holders of petroleum products and crude oil. When aggregated, the data reported by these sectors approximately represent the consumption of petroleum products in the United States. Data presented in the PSM are divided into the Summary Statistics and the Detailed Statistics. 12 figs., 46 tabs.

45231 (DOE/EIA–0121(89/1Q)) **Quarterly coal report, January–March 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 7 Aug 1989. 139p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE89015599/JAW. Available from NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.

The Quarterly Coal Report provides comprehensive information about US coal production, exports, imports, receipts, consumption, and stocks to a wide audience, including Congress, Federal and State agencies, the coal industry, and the general public. The data presented in this report are collected and published by the Energy Information Administration (EIA) to fulfill data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (P.L. 93-275) as amended. This issue presents detailed quarterly data for January through March 1989, aggregated quarterly historical and projected data for 1981 through 1990, and aggregated annual historical and projected data for 1960 through 2000. Appendix C displays, from 1980 on, detailed quarterly historical coal imports data, as specified in Section 202 of the Energy Policy and Conservation Amendments Act of 1985(P.L. 99-58). Appendix D gives selected quarterly tables converted to metric tons.

45232 (DOE/EIA–0125(89/1Q)) **Coal distribution, January–March 1989.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 1989. 90p. Sponsored by U.S. DOE Management & Administration. Order Number DE89016737/JAW. Available from NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.

The Coal Distribution report provides information on coal production, distribution, and stocks in the United States to a wide audience including Congress, Federal and State agencies, the coal industry, and the general public. The data in this report are collected and published by the Energy Information Administration. This issue presents information for January through March 1989. Coal distribution data are shown by coal-producing district of origin, consumer use, method of transportation, and State of destination. All data in this report were collected by the EIA in Form EIA-6, "Coal Distribution Report." A copy of the Form and the instructions for filing appear in Appendix C. 5 figs., 33 tabs.

45233 (DOE/EIA–0520(89/08)) **International petroleum statistics report.** USDOE Energy Information Administration, Washington, DC (USA). Office of Energy Markets and End Use. Aug 1989. 42p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE89016550/JAW. Available from NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.

This report presents data on international oil production, consumption, imports, exports, and stocks. The report has three sections. Section 1 contains time series on world oil production, and on oil consumption and stocks in the Organization for Economic Cooperation and Development (OECD). This section contains annual data beginning in 1973, and monthly data for the most recent two years. Section 2 presents an oil supply/consumption balance for the market economies (i.e. non-communist countries). This balance is presented in quarterly intervals for the most recent two years. Section 3 presents data on oil imports by OECD countries. This section contains annual data beginning in 1982, and quarterly data for the most recent two years.

45234 (DOE/FE–0140) **Public meetings for views and comments on the conduct of the 1989 Clean Coal Technology Solicitation: Denver, Colorado, January 18, 1989; Irving, Texas, February 2, 1989; and Atlanta, Georgia, February 16, 1989: Summary proceedings.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). Jul 1989. 96p. Sponsored by U.S. DOE Fossil Energy. Order Number DE89016685/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Three public meetings were convened by the Department of Energy (DOE) in January and February 1989 in order to obtain views, comments, and recommendations with regard to the forthcoming Clean Coal Technology III solicitation. In the sections that follow, brief descriptions are provided of the background to the CCT solicitation and the public meetings, and how the meetings were conducted. Subsequent chapters of this report present the discussions that ensued at each of the meetings, and the views, recommendations, and concerns that were expressed by attendees. Finally, an appendix contains a list of the organizations that were represented at the public meetings.

45235 (GOGLA–8902) **Environmental Studies Research Funds annual report, 1988.** Canada Oil and Las Lands Administration, Ottawa, ON (Canada). 1989. 60p. (In English and French). (MICROLOG–89-03779). Available from Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, Ont.,

CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Initiated in 1983, the Environmental Studies Research Funds (ESRF) is a program of funding for environmental and social studies related to oil and gas development on Canadian frontier lands. A focussed program, it deals exclusively with research to assist in decision-making related to oil and gas exploration and development. Funding for the ESRF is provided through levies on the oil and gas companies that hold interests on frontier lands. Administration is provided by the Environmental Protection Branch of the Canada Oil and Gas Lands Administration. Management of the ESRF was restructured in 1988 to include representation from the federal government, the oil and gas industry, the regional petroleum boards and the general public. The bulk of the technical work of the ESRF is performed by a series of Program Study Committees who provide expert advice in priority subject areas identified by the Board. These committees are comprised of scientific and technical experts from the oil and gas industry and the federal, provincial and territorial governments. This report summarizes the year's activities of the ESRF and includes descriptions of current research projects and a list of publications. In 1988, considering that frontier activity was low and that ESRF results needed to be evaluated and priorities for future studies determined, it was decided not to initiate new studies. Emphasis was placed on completing the studies already underway, publishing the results, and commissioning an independent evaluation/planning study. Abstracts of five recent reports are presented.

45236 (PMA–1988/1-6) **Canadian petroleum industry, 1988 monitoring report. First six months.** Petroleum Monitoring Agency, Ottawa, ON (Canada). 1988. 93p. (MICROLOG–89-03163). Available from Petroleum Monitoring Agency, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Petroleum Monitoring Agency was established in 1980 to provide the federal government with comprehensive and objective information on and analysis of the financial performance of the petroleum industry in Canada. The Agency publishes a semi-annual and an annual report based on information received directly from all but the smallest oil and gas companies. Data published are mainly aggregate data derived from survey schedules prescribed by regulations. This report presents a summary and highlights of the activities of the first half of 1988. Information is presented on corporate mergers and acquisitions; financial performance by sector (upstream, downstream, foreign) and total operations as seen by net income and cash flow; sources and uses of funds; a comparative performance by the petroleum and other industries as seen by net income and capital expenditures; ownership and control trends; international flows of funds; capital structures; and data related to income taxes. New features added in this report include expansion of the table representing the financial performance and profit margins of the refining/marketing segment to incorporate net income as a component of the analysis; analysis of the industry's use of exploration and investment tax credits; and a chart showing Canadian crude oil acquisition costs vs petroleum product prices. 12 figs., 63 tabs.

2950 Hydrogen and Synthetic Fuels

Refer also to citation(s) 44838

2960 Electric Power

Refer also to citation(s) 44953, 44995, 45165, 45172, 45208, 45229, 46189

45237 (DOE/EIA–0191(88)) **Cost and quality of fuels for electric utility plants 1988.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 11 Aug 1989. 232p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE89015596/JAW. Available from NTIS, PC A11/MF A01 - GPO - OSTI; GPO Dep.

The Cost and Quality of Fuels for Electric Utility Plants Annual (C&QA) includes comprehensive information about the electric utility industry in the United States. The C&QA presents annual summaries of electric utility statistics at the national, Census division, State, company, and plant level for quantity, quality, and cost of fuel data. The summarized data contained in this report are presented for the use of a wide audience including Congress, Federal and State agencies, the electric utility industry, and the general public. The data presented in this report were collected and published by the EIA, to fulfill its data collection and dissemination responsibilities as specified in the Federal Energy Administration Act of 1974 (Public Law 93-275) as amended. In addition to the Cost and Quality of Fuels for Electric Utility Plants Annual, the EIA publishes electric power data in the Electric Power Annual (EPA) (1), and the Electric Power Monthly (EPM) (2).

45238 (DOE/EIA–0474(89)) **Annual outlook for US electric power 1989: Projections through 2000.** USDOE Energy Information Administration, Washington, DC (USA). Office of Coal, Nuclear, Electric and Alternate Fuels. 26 Jun 1989. 87p. Sponsored by U.S. DOE Energy Information Administration. Order Number DE89015567/JAW. Available from NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.

Section 205 (a)(2) of the Department of Energy Organization Act (Public Law 95-91) requires the Administrator of the Energy Information Administration (EIA) to carry out a comprehensive program that will collect, evaluate, assemble, analyze, and disseminate data and information relevant to energy resources, reserves, production, demand, technology, and related economic and statistical information. To meet these responsibilities in the area of electric power, EIA has prepared this report entitled Annual Outlook for US Electric Power 1989. The report contains four chapters. Chapter 1 discusses important 1988 events in the electric power industry. Chapter 2 provides regional projections of sources and uses of electricity to the year 2000. Chapter 3 describes bulk power trade in the United States. Finally, Chapter 4 examines environmental legislation that may affect the electric power industry and provides emissions calculated from data collected on Form EIA-767. The appendices to this report provide detailed assumptions (Appendix A), regional projections of this year's forecast (Appendix B), and state-level emissions data (Appendix C). The report is intended for a general audience. It should be of particular interest to public utility analysts, policy and financial analysts, investment firms, trade associations, federal and state regulators, and legislators.

45239 (EPRI-CU–6367-Vol.1, pp. 1.1-1.15) **Determination of optimal residential appliance rebate levels.** Jenkins, J.C.; Vig, K.L.; Baumgartner, R.M.; Turcotte, P.M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In 1988, Northern States Power Company-Wisconsin (NSPW) conducted an extensive evaluation of its residential appliance rebate program. A key objective of the evaluation was to identify the optimal rebate levels for meeting the program's objective of increasing the efficiency of appliances purchased by residential customers. "Optimal rebate levels" are defined as those that encourage customers to purchase an efficient model, but also as those that are most cost effective for the utility. The evaluation also sought to identify customers' reasons for purchasing or not purchasing energy efficient appliances, to determine if the same number of efficient appliances would have been purchased in the absence of the program, to determine if customers became more aware of efficient appliances because of the rebate program, to identify attitudinal differences between participants and nonparticipants, and to identify the most effective target population to receive rebates. This results of this evaluation are presented.

45240 (EPRI-CU–6367-Vol.1, pp. 10.1-10.9) **Lessons learned in demand-side planning for Connecticut Light and Power's new building program: commercial sector.** Benner, N.; Christle, R.; McFerran, J.; Miller, K. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM

programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Portland Energy Conservation, Inc. (PECI) recently assisted Connecticut Light and Power (CLP) in the development of a demand-side management program. The development and operation of the resulting Energy Conscious Construction program is based on PECI's experience in designing and operating the Energy Edge demand-side management program used in the Pacific Northwest. This paper describes both programs and how PECI's experience with Energy Edge helped PECI and CLP plan the Energy Conscious Construction program.

45241 (EPRI-CU–6367-Vol.1, pp. 11.1-11.14) **Evaluation of the efficiency improvement potential in Ontario's new housing market.** Schneider, G. (Ontario Hydro, Toronto (Canada)); Hill, C.; Plagiannakos, T. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Ontario Hydro is planning to launch a number of efficiency-improvement programs beginning in 1989. In support of a proposed new housing program, this report presents preliminary results of an analysis to evaluate and quantify the electric efficiency improvement potential resulting from upgrading new conventional electrically-heated Ontario residential dwellings to the R-200 standard.

45242 (EPRI-CU–6367-Vol.1, pp. 12.1-12.16) **Audit predictions of commercial lighting and plug loads.** Pratt, R.G. (Pacific Northwest Lab., Richland, WA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Data for the Commercial Audit Program from buildings instrumented to collect end-use metered data as part of the End-Use Load and Consumer Assessment Program (ELCAP) is used to illustrate the uncertainty and range of error that can result from the energy audit process in commercial buildings. The implications of these results go far beyond these end-use loads themselves when it is recognized that the audit process involves subtraction of estimated lighting and plug loads from monthly billing data. This is then followed by efforts to match the predicted heating ventillation, and air-conditioning loads predicted by the remainder. This paper presents an end-use view of audit accuracy for lighting and plug loads.

45243 (EPRI-CU–6367-Vol.1, pp. 13.1-13.10) **Demand-side planning at New York's electric utilities: an assessment of initial efforts.** Gallagher, J.T. (New York State Dept. of Public Service, Albany (USA)); Seidman, P.; Swanson, S.M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper presents a summary of the Public Service Commission (PSC) staff analysis of the New York electric utilities' Long Range Demand Side Management (DSM) plans. The PSC staff recommended that all utilities develop and implement a common set of certain DSM programs systemwide, in addition to the DSM programs that address the special needs of the utilities' particular service territories.

45244 (EPRI-CU–6367-Vol.1, pp. 14.1-14.12) **When electric utilities will invest in energy efficiency.** Lachman, H.; Cillo, P.A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The paper presented discusses how the existing regulatory structure may have influenced the lack of investment in DSM (Demand Side Management). The authors propose some criteria for DSM program design. These criteria would enable the investor-owned utility (IOU) to use DSM to accomplish their corporate objectives within the current regulatory structure.

45245 (EPRI-CU–6367-Vol.1, pp. 15.1-15.13) **Issues in estimating free rider fractions.** Krause, F. (Lawrence Berkeley Lab., CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper explores problems inherent in quantifying free riders, problems with various measurement approaches, possible program design strategies for minimizing free rider impacts and uncertainties, and the impact of free rider fractions on program cost-effectiveness under the societal (total resource cost) and revenue requirements perspectives. It is found that free rider impacts on revenue requirements can be significant, while impacts on societal cost-effectiveness tend to be minor. In many cases, impacts on rates could possibly be reduced by using appropriate program design features. Monitoring approaches could also be improved, and utility experimentation with alternative program designs could be greatly expanded.

45246 (EPRI-CU–6367-Vol.1, pp. 16.1-16.5) **Linking electrotechnologies and industrial customers.** Lewis, L.; Squitieri, R.; Jeffress, R. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

IMIS is a PC-based information management system and analysis tool developed for use by industrial marketing staff, market planners, customer service representatives, forecasters, and energy systems analysts. IMIS provides organization and easy access to a utility's information about its industrial customers and identifies those industries and customers which have opportunities for electrotechnology and conservation technology applications. The complete system is menu-driven, with help screens available to assist users in operating the system. Although the current version of IMIS focuses on electrotechnology opportunities, future versions are expected to reflect the broader needs of the utility industry by including conservation, load-management, and load-shaping strategies.

45247 (EPRI-CU–6367-Vol.1, pp. 17.1-17.13) **Technology screening tools for marketing and DSM programs.** McMenamin, J.S. (Regional Economic Research Inc., San Diego, CA (USA)); Rohmund, I. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Commercial sector DSM and marketing programs necessarily deal with commercial building technologies. A complete analysis of

these programs requires consideration of technology characteristics, equipment operating strategies, and utility rates. The interaction among these factors is complicated, requiring structured analysis tools that go well beyond simple spreadsheets. To provide a uniform and well-tested approach, EPRI has developed COOLAID, COOLGEN and COMTECH, which are PC analysis tools for commercial building technologies. The focus of these programs is to provide utility analysts with a method for understanding the economic impacts of alternative technologies on equipment costs and utility bills, and for conveying these impacts to customers. COOLAID deals explicitly with cool storage. It is being used around the country for evaluation and marketing of cool storage systems. It allows the direct comparison of a variety of cool storage equipment options and operating strategies with conventional electric cooling systems under a broad range of utility rates. COOLGEN is a competitive assessment tool for gas cooling options. It allows evaluation of gas cooling technologies, cogeneration with heat recovery, and cogeneration with absorption cooling and compares them with conventional cooling and heating systems. With COMTECH it is possible to evaluate a variety of electric technologies, as well as gas-based alternatives. Included are conventional chillers and boilers, high-efficiency chillers and boilers, heat-recovery chillers and heat pumps, heat pump water heaters, cool storage systems, gas cooling technologies, and cogeneration packages with or without absorption cooling. The purpose of this paper is to discuss the uses and features of these programs.

45248 (EPRI-CU–6367-Vol.1, pp. 18.1-18.11) **Integrated resource planning and risk analysis using the MIDAS model.** Pryor, T.M. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The comprehensive risk analysis needed for integrated resource planning in today's uncertain environment requires many simulations and a multiobjective perspective. The simulation of numerous resource plan options under various assumptions yields reams of model output, the tedious comparison of which can demoralize even the most patient planner. The numerous simulations and what if scenarios needed to forge a robust resource plan require automation and organization. Separate mainframe planning models typically offer no help in evaluating and comparing the results of numerous individual simulations. The MIDAS model fills this void by facilitating the creation, comparison, and evaluation of multiple, fully integrated electric utility simulations.

45249 (EPRI-CU–6367-Vol.1, pp. 19.1-19.15) **Demand-side management option screening - an approach for company feasibility and customer acceptance evaluation.** Jacobson, B.B. (ICF Inc. (USA)); Taylor, E.F. Jr. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

For the past several years, Northeast Utilities (NU), Hartford, CT, has been engaged in the development of an integrated supply and demand planning evaluation process. The method developed was loosely based on the draft of the Electric Power Research Institute (EPRI) Demand-Side Management Intuitive Technical Matrix, but was updated for a much wider ranged of technologies. It was also translated into a quantitative PC-based spreadsheet model for ease of use and refinement. The customer acceptance evaluation was accomplished using the Alliance to Save Energy economic model ENVEST.

45250 (EPRI-CU–6367-Vol.1, pp. 2.1-2.16) **Applicability of load control to small commercial customers.** Chan, M.L.; Lineweber, D.; Heitzman, B. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In 1987, the City of Palo Alto, CA decided to investigate the cost effectiveness of load management for its small commercial customers. It was hoped that these customers could contribute towards the city's DSM program through some form of a load control program. This paper reports on the feasibility study that was conducted and the observations that may be applicable to other utilities that may be considering load management for small commercial customers.

45251 (EPRI-CU–6367-Vol.1, pp. 20.1-20.11) **Demand-side planning at Pacific Power.** Robison, D. (Lambert Engineering, Inc., Bend, OR (USA)); Peach, H.G. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Pacific Power and Light is one of the larger investor-owned utilities in the Pacific Northwest. The service territory is dispersed and consists primarily of small rural towns. The rural nature influences market characteristics in a manner quite different from other utilities. Transmission and distribution costs are a relatively large component of the cost of doing business. Residential customers frequently use wood as a heating fuel. Commercial customers tend to be very small, with relatively large heating load and little cooling load. Like other utilities in the Northwest, Pacific relies on relatively cheap hydro electricity for peaking needs. Thermal power plants provide the energy base load. These factors have created a system in which retail rates, including transmission costs, are somewhat higher than the marginal cost of new generation. Under these conditions, demand-side programs have a serious lost revenue impact. As a result, Pacific has formulated a corporate planning policy based on minimizing total bills by adopting the least cost resources.

45252 (EPRI-CU–6367-Vol.1, pp. 21.1-21.15) **Comparative assessment of the DSM plans of four New York utilities.** Goldman, C.A. (Lawrence Berkeley Lab., CA (USA)); Kahn, E.P. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. DOE Contract AC03-76SF00098. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In September 1987, the New York Public Service Commission (PSC) directed each of the state's seven investor owned utilities to develop a long-term Demand-Side Management (DSM) Plan that would assess the potential for DSM in its service territory and identify cost-effective programs to capture that potential. The authors reviewed the DSM plans at four utilities: Consolidated Edison, Rochester Gas & Electric, New York State Electric and Gas, and Niagara Mohawk Power Company. This study summarizes the current load/resource balance of the New York utilities, then discusses the technical and market potential for DSM identified by each utility and the relative impact of DSM on future load growth, finally offering some suggestions for improving future DSM plans.

45253 (EPRI-CU–6367-Vol.1, pp. 22.1-22.19) **Economic evaluation of demand-side programs considering customer value.** Hobbs, B.F. (Case Western Reserve Univ., Cleveland, OH (USA)); Nelson, S.K. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs:*

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When are subsidies of conservation investments economic? Conflicting answers have been offered to this question, sowing confusion among regulators and electric utility planners. In this paper, a new, more general criterion is proposed for justifying demand-side programs (DSPs). This criterion maximizes net benefits to consumers by considering not only utility and consumer costs, but also the real economic costs caused by changes in electric rates associated with such programs. Unlike previous criteria, this one accounts for two market failures that should be of concern to utility planners: (1) consumers may not make conservation investments that are economically justified by the electric rates they face, and (2) rates are based on revenue requirements, not marginal cost.

45254 (EPRI-CU–6367-Vol.1, pp. 23.1-23.11) **Interfuel substitution analysis: an integrated planning approach to comparing the benefits and costs of fuel switching.** Mikulec, R.J. (Wisconsin Electric Power Co., Milwaukee (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Gas utilities across the country are encouraging customers to switch from electric to gas technologies for select end uses. These solicitations are often based on a relatively crude cost/benefit analysis which is performed from the customer's perspective. This approach masks the true economics of interfuel substitution, since the analysis is performed using average rather than marginal costs for gas and electricity. A case study of this involving Wisconsin Electric Power Company, the Public Service Commission of Wisconsin, and a competing gas utility is presented.

45255 (EPRI-CU–6367-Vol.1, pp. 24.1-24.15) **DSM benefit-cost analysis revisited.** Hanser, P.; Braithwait, S.D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A number of issues arise consistently in discussions of cost-benefit analysis and cost-effectiveness regarding utility demand-side management (DSM) planning. These issues can be reasonably divided into two broad categories. One includes overall issues of the appropriate perspectives, or criteria, by which the cost-effectiveness of DSM programs should be judged. The other category includes more detailed objective or quantitative issues regarding reasonable estimates of market penetration, energy and load impacts, and costs. This paper attempts to clarify a number of these issues from the perspective of cost-benefit, and identify those areas where better information is needed in the form of quantitative data, versus those areas where what is needed is sharp thinking to narrow the issues to a few well-defined questions.

45256 (EPRI-CU–6367-Vol.1, pp. 25.1-25.11) **Assessing the effects of demand-side programs on transmission planning.** Alvarado, F.L. (Univ. of Wisconsin, Madison (USA)); Ray, D.J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The spatially distributed effects of demand-side programs will alter transmission line loadings and transmission reliability. As a consequence, the planning of transmission facilities will have to consider the design objectives and implementation strategies of these demand-side programs. Conversely, the nature of transmission systems should influence the selection and design of demand-side programs. Of particular concern is that transmission restrictions, when they occur, can impose significant limits on the delivery of electrical energy. The authors argue that to properly account for these restrictions and their effects upon reliability, research is needed to create measures of transmission system reliability that are quantifiable and differentiable, and that have an establishable relationship to expected outage costs. In the meantime, they suggest that demand-side planners work with transmission planners to develop a mutual understanding of the effects of demand-side programs on transmission reliability.

45257 (EPRI-CU–6367-Vol.1, pp. 26.1-26.3) **Review of Stone and Webster's DOE LCUP study.** Buttorff, L.A. (Stone and Webster Management Consultants, Inc. (USA)); Calafiore, A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Evaluating demand and supply options on an equal basis as part of a Least Cost Utility Planning (LCUP) analysis requires a broader perspective than is required for traditional supply planning studies. The models used to carry out the evaluation require additional features than those traditionally used for supply planning. The approach taken includes consideration of both the demand- and supply-side options, and thus requires additional information on the demand-side option's behavior and system impacts. To evaluate this integrated planning process, determine a process that successfully addressed these problems, and provide a real life example of how to conduct an integrated planning analysis, a project - partially funded by the Department of Energy (DOE) as part of its Least Utility Planning program - was undertaken. This project combined the demand- and supply-side planning expertise of Stone and Webster and the actual data (both demand-side and supply-side) of two participating utilities, along with the expertise at each utility, to carry out a Least Cost Planning Analysis.

45258 (EPRI-CU–6367-Vol.1, pp. 27.1-27.13) **Using a comprehensive market planning and analysis system to develop cost-effective DSM programs for 34 municipal utilities.** Fitzemeyer, P.; Sinha, J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The Massachusetts Municipal Wholesale Electric Company (MMWEC) and Synergic Resources Corporation (SRC) recently concluded a major demand-side study for MMWEC's 33 members. (The 34th utility mentioned in the title of this presentation was located in Rhode Island; though not an MMWEC member, it asked to be included in this project.) This effort was notable in the detail and sophistication of the analysis and the manner in which a group of utility managers, relatively skeptical of DSM, were successfully convinced of its potential. The authors first describe the general context in which the study was initiated and its objectives. Next, they detail how the data to support the analysis were collected and verified. SRC's COMPASS market planning system was used for the program analysis and several of its key features are highlighted. Finally, the authors provide a summary of the major findings from this study and how they are being applied.

45259 (EPRI-CU–6367-Vol.1, pp. 28.1-28.11) **Are appliance rebate programs cost-effective? Some experimental results.** Flaim, T. (Niagara Mohawk Power Corp. (USA)); Miedema, A.K.; Clayton, C.A. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May

1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In 1985, Niagara Mohawk Power Corporation (NMPC) initiated a Residential Financial Incentives Pilot Study to determine the effects of rebates on the purchase of energy-efficient appliances and of subsidies on the demand for low-cost conservation measures. This paper presents the results from the appliance portion of the pilot study.

45260 (EPRI-CU–6367-Vol.1, pp. 29.1-29.9) **Residential on-site load control program evaluation and end-use analysis.** Hard, D. (Arizona Public Service Co., Phoenix (USA)); Adamczyk, T. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper summarizes the preliminary findings of a 1987-1988 Arizona Public Service Company (APS) study conducted to evaluate coincident and noncoincident demand impacts and energy consumption shifts for residential customers with customer-owned on-site load control devices. Additionally, this project was designed to collect and analyze end-use data on a monthly, seasonal, and annual basis. This research involved comparing two samples, each consisting of 50 dwellings with well-matched demographic characteristics, over a period of 18 months. Total dwelling energy consumption and demand was evaluated along with the following electric end-use data: space conditioning, water heating, range, clothes dryer, and swimming pool pump. At this writing, only ten months of the 12-month seasonal year (November 1, 1987 - October 31, 1988) have been analyzed, and therefore these results are preliminary.

45261 (EPRI-CU–6367-Vol.1, pp. 3.1-3.7) **Evolution of rebate programs: from conservation to customer service through demand-side management.** Ignelzi, P.C.; Ridge, R. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Southern California Edison (SCE) has offered rebates to commercial and industrial customers for the installation of efficient equipment since the late 1970s. At its inception, the Hardware Rebate Program (HRP) was designed as a firm initiative to help customers conserve energy, save money, and cut peak load. While the program has operated continually, the company's strategic goals have changed with the times. This paper is an instructive chronicle of how an energy conservation program has been transformed into a successful demand-side management tool.

45262 (EPRI-CU–6367-Vol.1, pp. 30.1-30.8) **Ten years after: lessons learned from the residential direct control program.** Malcolm, W.H. (Pacific Gas and Electric Co. (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Pacific Gas and Electric Company (PG and E) was the nation's pioneer in using demand-side management to deal with the energy deficiencies facing California in the late 1970s and early 1980s. One of the first demand-side projects to be established by PG and E was the Residential Peak Load Reduction Project (RPLRP). This experiment interrupted residential customers' air conditioners using radio-controlled switches installed on the air conditioners. The major goals of the experimental Residential Peak Load Reduction Project were as follows: Load reduction: to operate a program that would provide a competitive resource option. Experimentation: to obtain information on the effectiveness of a variety of interruption strategies and incentive levels from the perspective of both economic benefits and customer relations. This included evaluating customer acceptance, technology, and economic feasibility. The program was operated from 1977 until 1987, when it was terminated (primarily because PG and E was no longer capacity constrained). In this paper, the author will present an overview of the program design and operations during the 11-year period and focus on lessons learned during this period.

45263 (EPRI-CU–6367-Vol.1, pp. 31.1-31.11) **Federal technology, policy and program options in least-cost utility planning.** Pirkey, D. (Dept. of Energy, Washington, DC (USA)); Millhone, J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The U.S. Dept. of Energy's electric utility demand-side management program was initiated in 1986. Congressional guidance of the program was broad, stating the funds were to initiate a Least-Cost Utility Program (LCUP) to assist utilities in choosing service options and conservation programs which will provide efficient and low-cost service to customers. From the outset, DOE has insisted that the LCUP program include both electric and natural gas utilities, but in fact has been almost exclusively an electric utility program. The background behind this program is discussed, and DOE activities in the following areas are discussed: (1) What are the technical savings potential of Least-Cost Utility Programs?; (2)How reliable are Least-Cost Utility Programs?; (3)Bidding for conservation - How does bidding fit into a Least-Cost Plan?; (4) What are the non-economic reasons for Least-Cost Utility Programs?; (5) Where will Least-Cost Utility Planning be implemented?; and (6) International Least-Cost Utility issues.

45264 (EPRI-CU–6367-Vol.1, pp. 32.1-32.15) **US Department of Energy's least-cost utility planning program.** Berry, L. (Oak Ridge National Lab., TN (USA)); Hirst, E. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The U.S. Dept. of Energy (DOE) is playing a small, but meaningful role in ensuring that the large potential of the Least-Cost Utility Program (LCUP) is realized. DOE's LCUP program involves both large and small, public and private utilities, state energy offices and public utility commissions, research and trade associations, and experts at consulting firms and national laboratories. DOE's program has funded projects related to data bases; model review and development; legal issues; methods for incorporating renewable resources and cogeneration into utility plans; creation of new organizations and consensus-building processes; analysis of demand-side bidding mechanisms; risk and uncertainty; demand-side technology assessments, market penetration studies, and supply curves; and handbooks, conferences, and other technology-transfer efforts.

45265 (EPRI-CU–6367-Vol.1, pp. 33.1-33.11) **Estimating the capacity and energy resource value of DSM programs: case specific production cost/financial models vs screening methods.** Clarke, R.H. (San Diego Gas and Electric, CA (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number

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Many DSM cost effectiveness methods and computer evaluation models use screening methods to determine the capacity and energy resource value of DSM options. A recurring question is: how do these screening results differ from those obtained when detailed production cost and financial analyses are conducted on a case-by-case basis for each DSM option under consideration? This paper discusses the results of comparing these two methods for a summer-peaking utility with a peak load of approximately 2500 MW (1).

45266 (EPRI-CU–6367-Vol.1, pp. 34.1-34.9) **Developing a strategic marketing plan: the case of two utilities.** Reynolds, S. (Tennessee Valley Authority (USA)); Roddy, M.; Davis, T.D. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The purpose of this paper is to review the lessons of experience by looking at two different utilities that recently developed strategic marketing plans. A case study approach was used to review the process leading to and the results of the efforts by TVA and JCP and L. A partial listing of the strategies and programs developed by the two utilities and the progress to date are also presented. Finally, the implications for other utilities that may be contemplating the development of strategic marketing plans are also presented, along with an identification of issues that may arise.

45267 (EPRI-CU–6367-Vol.1, pp. 35.1-35.7) **Market segmentation and altering DSM promotion strategies - two techniques to assure continued success.** Lynk, F.A. (Public Service Electric and Gas Co., Newark, NJ (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Public Service Electric and Gas Company (PSE and G), the third largest combined electric and gas company in the US, provides services to 2.0 million customers in New Jersey. Like other large utilities, for the last ten years, PSE and G has been managing many DSM programs, starting with RCS. The PSE and G promotional effort for DSM programs has always been extensive. Coordinated multiple media forms such as TV, radio, and print have been used to achieve targeted participation rates. However, in the last two to three years, as energy prices have stabilized, interest in conservation has waned, promoting DSM programs has become more difficult and costly. PSE and G has had to modify its approach and today relies more on telemarketing and customized promotions for specific market segments. This paper addresses two specific programs and discusses how PSE and G's promotional strategy has changed over time and what is planned for the future. The two programs are the Home Energy Savings Program (HESP), as RCS programs are known in New Jersey, and the E-Team, which includes all of PSE and G's low income weatherization programs. PSE and G has extensive experience and here offers insights into what works in promoting DSM programs.

45268 (EPRI-CU–6367-Vol.1, pp. 36.1-36.14) **Developing a marketing strategy for the direct load control of electric water heaters.** Cosgrove, S.J. (Cambridge Reports, Inc., MA (USA)); White, D.S.; Rossi, S.M.; Banks, J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper highlights some of the findings of New England Power Service Company's (NEPSCo) marketing research to support efforts to encourage customers to participate in a direct load control (DLC) program. The study design reflects the expressed requirements of New England Electric System (NEES) companies to fashion an overall market strategy for the direct load control of electric water heaters. The approach used for this project utilized a number of diverse methodologies, including focus groups, conjoint analysis, Donnelley cluster coding, and a matched sampling survey design.

45269 (EPRI-CU–6367-Vol.1, pp. 37.1-37.15) **Developing reliable data on DSM programs: the NORDAX experience.** Camera, R.K. (Synergic Resources Corp. (USA)); Stormont, D.; Sabo, C. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The NORDAX project seeks to reduce the uncertainty associated with these topics through the collection and organization of DSM program data from Northeastern utilities. Its objective is to combine DSM program experiences in a systematic fashion using a database will establish the range of estimates for key parameters and, consequently, improve program evaluation as part of the integrated planning process in the Northeast. This paper discusses how this specific objective is being attained in terms of the NORDAX database software and the DSM program data collected in Phase I. An illustration will be offered using information from the database to demonstrate the analytical capabilities of the software system developed for NORDAX. The problems and limitations of using the information will be discussed and possible solutions will be offered. Since Phase II of NORDAX will have commenced by the time this report is presented, it is possible that some of the observations and suggestions offered will be considered and implemented during the course of Phase II.

45270 (EPRI-CU–6367-Vol.1, pp. 38.1-38.10) **Using market segmentation in program planning: PG and E case study.** Barnes, R.S. (Pacific Gas and Electric Co. (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1<150>EPRI-CU–6367-Vol.1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Marketing programs must be targeted at small market segments if they are to be successful and cost-effective. Programs that are directed at the entire commercial or industrial sector will not meet the needs of the customers or the utility. PG and E has addressed this problem by segmenting the market into small market segments. The segments are given a preliminary priority ranking to determine which segment will be studied first. Each segment is analyzed to determine market trends and drivers, identify opportunities and risks, and recommend marketing objectives and strategies used for program development. This three-step process of segmenting, ranking, and segment analysis provides PG and E with information that is used in producing marketing plans and programs that are designed for specific customer segments. Each market segment may have potential new sales opportunities or desire particular energy-related services. The services cover a wide range of programs, including rate options, equipment purchases consultation, power quality consultation, conservation assistance, and improvement of various business functions.

45271 (EPRI-CU–6367-Vol.1, pp. 39.1-39.13) **Integrating program design, implementation, and evaluation: lessons learned in Wisconsin Electric's Smart Money Program.** Wilder, S.V. (Wisconsin Electric Power Co., Milwaukee (USA)); Hoch, L.J. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs:

demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

In 1987, Wisconsin Electric Power Company (WE) designed and implemented the $72.9 million Smart Money program, which serves as an umbrella marketing identity for nine separate programs targeted at all major customer classes. The goal for the first two years of the Smart Money program was to produce a gross demand reduction of 170 MW. This program is discussed.

45272 (EPRI-CU–6367-Vol.1, pp. 40.1-40.11) **Integrating demand-side management into least-cost resource planning.** Lawrence, D. (Central Maine Power Co., Augusta (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Central Maine Power's (CMP) approach to least-cost integrated planning is presented. It was found that greater communication and cooperation between utility departments was needed. CMP's linear programming model was developed to integrate supply-side and demand-side options into resource inputs. This model is discussed.

45273 (EPRI-CU–6367-Vol.1, pp. 41.1-41.15) **Use of marginal-cost-of-service analysis to examine end-use profitability for electric utilities.** Hirst, E. (Oak Ridge National Lab., TN (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper presents results from a marginal-cost study for a hypothetical utility in the Pacific Northwest. Study results are used to assess different types of customer programs aimed at improving energy efficiency, retaining market shares, or increasing sales. The examples concern retention of existing residential water-heating loads (which would otherwise be lost through conversion to natural gas), promotion of high-efficiency electric space-heating in new homes, and promotion of area lighting for commercial buildings. Each example yields different insights about costs and revenues; their changes over time; and their sensitivities to load shapes, rate structures, and measure lifetimes.

45274 (EPRI-CU–6367-Vol.1, pp. 42.1-42.15) **Conceptual framework for integrating DSM in utility strategic planning.** Hamblin, D.M.; Norland, D.L.; Miller, B. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A conceptual framework for integrating DSM in utility strategic planning is presented. The key feature in the approach is the construction and presentation of Resource Mix Probability Maps showing a resource mix's ranking by a given decision criterion in each important "story" about the future. This is not the complete strategic planning process, however. Human resources, organizational structure, corporate cultures and subcultures, etc., also affect strategy formation and implementation. These factors can also be treated in our conceptual framework and constitute one direction of our future research.

45275 (EPRI-CU–6367-Vol.1, pp. 43.1-43.14) **Integrating market research information with end-use load data for analysis of technologies' acceptance and efficiency.** Smith, B.A.; Shirilau, M.S. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper discusses several results from the Residential Energy Usage Comparison (REUC) Project, being conducted at Southern California Edison Company (SCE) and jointly managed with the Electric Power Research Institute (EPRI) under research project 2342-7. As described below, the REUC Project is a pioneering demand-side program undertaken to calculate the efficiencies of new end-use technologies, to assess the market for competing end-use technologies, to understand how and why SCE's residential customers make fuel and end-use technology choices, and to comprehend how they decide to utilize these energy-consuming technologies. The REUC Project analyses have utilized two techniques to gain this understanding that have integrated market research information with end-use load data. They have called these analysis approaches Behavioral Engineering Statistical Techniques (BEST) and Integrated Market Research (IMR) analysis.

45276 (EPRI-CU–6367-Vol.1, pp. 44.1-44.9) **Marketing demand-side management: the large customer's perspective.** Gilbert, J.S. (Dames and Moore (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The author's work with 64 electric utilities illustrates some predictable patterns. Where the utility is customer driven and proactive in their marketing posture, consistency and effectiveness are likely. On the other hand, program driven utilities tend to confuse customers with their shift in program emphasis over time. The change towards becoming customer driven is subtle, once customer interaction is understood from their perspective. The authors have summarized their observations in this paper and present a structure for the correct balance between marketing and capacity planning objectives. Identification of the large customer's business objectives is central to that effort. DSM technologies can then be applied to meet specific customer needs. Otherwise, customers see utilities expressing DSM objectives as a statement of the utility's inability to manage their future rather than as an expression of corporate capability. The consequence is that customers lose interest in or become suspicious of the utility interaction, which in turn slows implementation progress and increases utility program costs.

45277 (EPRI-CU–6367-Vol.1, pp. 45.1-45.10) **Incorporating uncertainty in DSM market penetration forecasting and implications for utility marketing strategies.** Scheer, R.M.; Caskey, J.F.; MacDonald, A.I. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper offers some suggestions for how to best incorporate uncertainty into demand-side management (DSM) planning and to develop the flexible approaches that will be needed in DSM marketing. Virginia Power pursues a corporate strategy that recognizes the problems associated with the uncertainties in the energy market. Results are presented from efforts to develop and implement that corporate strategy.

45278 (EPRI-CU–6367-Vol.1, pp. 6.1-6.9) **Moving towards more coordinated energy efficiency programs.** Johnson, P. (Alliance to Save Energy, Washington, DC (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4.

national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This paper explores joint, state-utility energy efficiency projects for a utility's perspective. It explains the work that the Alliance to Save Energy (ASE) is doing in this area and profiles joint projects that have been set up to date. Particular attention is given to the diversity of approaches that have been used to set up and operate these projects. The authors describe the process they have followed to help set up joint projects in several states and offer suggestions to utilities based on these experiences.

45279 (EPRI-CU–6367-Vol.1, pp. 7.1-7.13) **Using dispatchable price signals to manage high-cost peak load.** Quadrini, P.J. (Pacific Gas and Electric Co. (USA)). Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Traditional load management programs have used mechanical and electronic devices to automatically curtail a customer's use of electricity during times of scarce electric resources. Time-of-use programs have used high peak charges to shift customer usage from a time period where marginal costs are high to time periods where marginal costs are low. What happens when these two approaches are combined and customers are charged an extremely high rate only when resources are scarce or expensive? This paper examines the effectiveness of dispatchable price signals in curtailing loads during period of high-cost peak demand.

45280 (EPRI-CU–6367-Vol.1, pp. 8.1-8.6) **Assessing industrial electrification and economic development pricing initiates in the context of demand-side management concerns.** Doering, O. (Purdue Univ., Lafayette, IN (USA)); Cearley, R.; Frye, E.; Holland, F.; McKinzie, L.; Preckel, P.; Sparrow, T. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The paper presented develops an analytical framework for helping public utility commissions to evaluate industrial electrification initiatives that represent a Pareto improvement for society. The approach suggested here relies heavily on a mix of existing models for utility planning and operation and industrial process models. It was concluded that incentive rate designs exists which allow customers with opportunities to use additional purchased electricity profitably, while at the same time insuring that all existing customers are made better off in all time periods. It was further concluded that one such design is a "two-tier" price, one for the duration of the new period of excess capcity and one for the period when new capacity must be built.

45281 (EPRI-CU–6367-Vol.1, pp. 9.1-9.12) **Function of electricity discount rates in the economic development of a state.** Okure, T.U.U. Electric Power Research Inst., Palo Alto, CA (USA); Synergic Resources Corp., Bala-Cynwyd, PA (USA). Apr 1989. (CONF-890510–Vol.1: 4. national conference on utility DSM programs: demand-site management strategies for the 90's, 2-4 May 1989). In *Demand-side management strategies for the 90s. Proceedings: Fourth national conference on utility DSM programs: Volume 1.* Order Number DE89010849/JAW. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A number of studies (which are briefly reviewed in this paper) have made attempts to evaluate the effectiveness of discounted energy programs. These studies have drawn negative conclusions about the effects of these discount programs. The paper presented discusses energy (electric) discount programs from a state perspective, and contends that the problem with many of these studies is the failure of the analyst to examine the less obvious benefits of the discount programs. In addition, one of these studies uses an economic model of a purely academic type which calculates the results on the basis of unrealistic input assumptions.

45282 (EPRI-EL–6484) **Decomposition techniques for multi-area generation and transmission planning under uncertainty: Final report.** Dantzig, G.B.; Glynn, P.W.; Avriel, M.; Stone, J.C.; Entriken, R.; Nakayama, M. Electric Power Research Inst., Palo Alto, CA (USA); Stanford Univ., CA (USA). Dept. of Operations Research. c Aug 1989. 121p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This research is concerned with developing software tools for finding optimal resource expansion plans for large scale power systems. An acceptable expansion plan must be capable of reliably supplying demand in the face of uncertainty about future demand and availability of generators and transmission lines due to equipment failures. The incorporation of uncertainty into the resource planning model of an electric power system is essential. Unfortunately, the number of possible contingencies that must be hedged against can run in the millions. There are no off-the-shelf algorithms available to solve the problem in general. This report, nevertheless, shows how these problems, though very very large in size can be solved by applying improved methods such as decomposition techniques in combination with importance sampling and the exploitation of advanced computer technologies (parallel processors). The methodology is described and applied to a stochastic version of the Western Resource Planning Model for the west coast. Experimental results are presented. 2 refs., 5 figs., 6 tabs.

45283 (ERCB–D88-19) **TransAlta Utilities Corporation 138-kV transmission line facilities North Lethbridge-Tempest area.** Energy Resources Conservation Board, Calgary, AB (Canada). [1989]. 17p. (CE–02761). Available from Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

TransAlta Utilities applied for the necessary permits, licenses, and approvals to construct and alter substations, construct and salvage transmission lines, and interconnect the new facilities with the existing power transmission system. Two possible transmission line routes were proposed, and a hearing was held to consider matters relating to the application. Issues considered at the hearing were the need for the proposed transmission system changes, and the location of the proposed transmission line. The applicant felt that the existing 69-kV system was not adequate for supplying peak loads in the summer, when a significant portion of the load is for irrigation pumping. It was agreed that the existing system needs upgrading to avoid low-voltage conditions resulting from equipment outages. Regarding the location of the proposed line, interventions were heard by local landowners presenting certain objections related to physical interference of the line with irrigation systems, access to property, esthetic impact, electromagnetic health hazards, and danger to helicopter pilots landing at a proposed helipad to be located near the proposed line. After considering the evidence, the applicant's preferred route was approved, subject to certain conditions. These included structural modifications to allow operation of pivot irrigation systems along the proposed line, and the use of sufficient two-pole structures no more than 10 m high to allow coexistence of the proposed line with the proposed helipad. 3 figs.

45284 (HQ–1988) **Hydro-Quebec annual report, 1988.** Hydro-Quebec, Montreal, PQ (Canada). 1989. V (In French). (MICROLOG–89-03165). Available from Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, PQ, CAN H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This annual report for the Quebec electric utility presents an overview of the year's activities and its financial status, including export sales of electricity to New Brunswick, Ontario, New York State, and the New England states. Research programs and demonstration projects are described, as well as the utility's activities in Africa and Asia. Environmental and economic considerations for the

province are presented. Financial data includes total sales, sales by sector, export sales, and rate changes. A financial statement is included. 10 figs., 4 tabs.

45285 (HQ–8903) **[Hydro-Quebec] Proposed tariffs for 1989.** Hydro-Quebec, Montreal, PQ (Canada). 1989. 38p. (In French). (MICROLOG–89-03179). Available from Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, PQ, CAN H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Patrons of the Quebec market would prefer foreseeable prices which are advantageous with respect to the other energy sources and beneficial at the international level. The rates strategy in the coming years will also respect the following guiding principles: to maintain the territorial uniformity of the rates and to treat similarly clients with similar consumption characteristics; to translate, as far as possible and gradually, into the rates the cost associated with the delivery of the various products; to make easier the understanding and application of the rate tariff; to take into consideration the operating modes of customers. After a brief description of the evolution of energy prices and of the financial situation of Hydro-Quebec, this statement presents the tariff proposition for 1989. It mentions next the tariff orientations which have been considered for the market of surplus electricity in Quebec. The effect of the proposed rate increase, which has an average value of 4.7%, on each of the tariff categories is detailed. Two new tariffs for large power users are also introduced. 2 figs., 16 tabs.

45286 (IVA–364, pp. 9-31) **Role of electricity in the future energy system. Electricity production and use in the OECD countries.** Foster, S. (International Energy Agency, Paris (FR). Office of long-term co-operation and policy analysis). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. (CONF-8811244–: The role of electricity in the energy systems of the future, 23 Nov 1988). In *Role of electricity in the energy systems of the future.* Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

For the rest of this century and beyond, the electricity industry in OECD countries faces a period of uncertain growth. The industry also faces major changes both in the environment in which it works and in its own organization. The response to this changing situation will require institutional, technological and policy approaches. It is essential to get this response right to create conditions where adjustments can occur smoothly and efficiently, which is more likely to happen if there is wide public debate. This conference is an important contribution to such debate. We can now turn to the surveys of electricity issues in the specific countries. Thank you.

45287 (IVA–364, pp. 33-42) **Use of electricity in Sweden.** Albinsson, H. (Federation of Swedish Industries, Stockholm (SE)). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. (CONF-8811244–: The role of electricity in the energy systems of the future, 23 Nov 1988). In *Role of electricity in the energy systems of the future.* Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

Most of the electricity today generated in Sweden comes from hydropower stations and nuclear power stations, each of them supplying about 65TWh per year. Today about twice as much electricity is used as in 1970. The low variable costs of nuclear power, in combination with some degree of surplus generating capacity, has acted as a brake on electricity price growth. During the 1970s industry did not expand as predicted. The consumption of electricity in industry stagnated during the period 1974-1983. On the other hand growth continued within the other sectors of society, particularly in space heating. The nuclear power programme was cut back but power plants already decided on were constructed, which gave the scope to substitute oil with electricity for heating purposes. Swedish industry has increased its use of electricity, not only in absolute but also in relative numbers. The reason is the development of the price ratio fuel/electricity, and a number of advantages for the consumers i.a. better product quality and lower investment and maintenance costs. Energy conservation will continue to play an important role in the Swedish energy policy. The greatest gains in energy efficiency improvements in industry will come through improvements in process technology requiring great investments. In the long run it will certainly be necessary to switch from oil and natural gas to coal, nuclear, solar and other sources of primary energy. In this transition process electricity will play a very important role.

45288 (IVA–364, pp. 43-65) **Electricity in Finland.** Korpela, T. (Imatran Voima Oy, Helsinki (FI)). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. (CONF-8811244–: The role of electricity in the energy systems of the future, 23 Nov 1988). In *Role of electricity in the energy systems of the future.* Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

Historically we find a clearly saturating growth of industrialpower consumption per total gross domestic product (GDP), and continuously strong increase of the corresponding figure in private and service consumption. A forecast of the Electric Power Producers Council, predicts a dramatic trend break in the development of specific power consumption in private and service sectors. This would also lead to a corresponding trend break in the total specific power consumption of the Finnish national economy. This trend continues well beyond the year 2000, with also GDP growth eventually saturating. Whether or not such a trend break will occur and when it will occur remains to be seen. That it should happen in the coming 5 to 10 years seems to be wishful thinking. Such an outcome is incompatible with the expected economic growth and stable electricity prices. Of course, it is quite certain that the growth of electricity consumption cannot continue for ever. For the time being the growth still is assumed to go on in Finland. This is an outcome from two basic assumptions: The economic growth will continue, and in energy end uses electricity will continue gaining market shares. In that sense the already big role of electricity is going to be bigger still in the future.

45289 (IVA–364, pp. 67-82) **IVA-Conference on the future role of electricity. Abstract of country survey for Denmark.** Buelow, H. von (Energiministeriet i Danmark, Koebenhavn (DK)). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. (CONF-8811244–: The role of electricity in the energy systems of the future, 23 Nov 1988). In *Role of electricity in the energy systems of the future.* Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

The lecture presents: * Production and use of electricity today and in future, * Plans for expansion of production system, * Environmental demand for production plants, * Today's and tomorrow's prices, sensitivity in different sectors, * The future energy system (after 2000).

45290 (IVA–364, pp. 83-117) **Role of electricity in the future energy system in the Federal Republic of Germany (FRG).** Zoellner, J. (Hauptberatungsstelle fuer Elektrizitaetsanwendung, Frankfurt/Main (DE)). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. (CONF-8811244–: The role of electricity in the energy systems of the future, 23 Nov 1988). In *Role of electricity in the energy systems of the future.* Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

Problems of recognizing the interdependence of energy conservation and environment protection, attain only very recently a certain, but steadily increasing attention. Especially the CO_2 problem stands for this new thinking. Every energy conservation policy should in no event result in a massive impairment of other socially relevant parameters, as the environment protection, but also the economic situation. The idea of energy conservation should likewise not lead to the situation that the socially relevant benefit that is derived from any application of energy will not be achieved anymore or will unduly be impeded under the view of energy conservation. In the field of energy production, the electricity supply industry has developed a balanced and future-oriented concept which includes also the use of nuclear energy. But also in the field of electricity application, and thus in the field of energy conservation, appropriate attention will be paid to objectives, as far as they apply to ecologic, economic and other socio-politically relevant considerations. We feel that electric energy is a prime mover on the way to a new, information and service-oriented society. Any policy, which impairs electric energy arbitrarily, implies the danger of restricting this economic and social development.

45291 (IVA–364, pp. 119-124) **French energy policy: A privileged place for electricity.** Stoffaes, C. (Electricite de France, Paris (FR). Direction de la Prospective). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. (CONF-8811244–: The role of electricity in the energy systems of the future, 23 Nov 1988). In *Role of electricity in the energy systems of the future.* Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

The production structure has been completely transformed since 1973, in two stages. The first stage was a reconversion to coal to reduce the quantity of fuel oil burned in power plants, while awaiting the construction of nuclear plants. The second phase was the fairly concentrated arrival of committed generators. The total installed power which was at least 10 GW in 1979, increased to 20 GW in 1981, and 45 GW in 1986. This transformed the French production structure for the second time in ten years. As a result, EDF's coal consumption, which was the main factor of development in French coal consumption over the past ten years, is now collapsing. The nuclear sector accounted for 85% of electricity production in 1985. This level was much higher than in other countries (24% in Germany in 1984). The growth in electricity consumption is considerable, between 4.5 and 5.5 % per year over the past few years. Beyond the natural growth in consumption resulting from economic growth, an active policy for penetration of economically high-performance uses of electricity has been laid down. The restructuring of the electrical production system has made it possible to control the impact on prices of electricity derived from the increase in fossil fuels. The recourse to nuclear energy, which is less costly than fuel oil and coal, was the decisive factor in this action.

45292 (IVA–364, pp. 125-129) **Electricity and energy in Quebec (Canada).** Neveu, G. (Hydro Quebec, Montreal (CA)). Royal Swedish Academy of Engineering Sciences, Stockholm (Sweden). 1989. (CONF-8811244–: The role of electricity in the energy systems of the future, 23 Nov 1988). In *Role of electricity in the energy systems of the future.* Order Number DE89902444/JAW. Available from NTIS (US Sales Only), PC A07.

In 1986, electricity consumption accounted for 40 % of the total energy needs in Quebec. Shares of oil and gas were 43 % and 14 % respectively. Energy consumption in Quebec has experienced drastic changes over the past 15 years. Actually, 15 years ago, the breakdown was: electricity 20 %, oil 74 %, gas 5 % and other 1 %. The forecast is for a further increase in the share of electricity (42 % in year 2006). Overall energy consumption grew annually by only 0.5 % between 1971 and 1986 mainly because of a significant energy saving effort in the 1981-1983 period. The forecast for the next 20 years is about 1.5 % per year. Hydro-Quebec's development plan assumes that electricity sales will grow 2.7 % per year for the next 20 years. This compares to a 5.4 % growth rate between 1971 and 1986. In the past, electricity sales have been driven by electric heating in the residential sector. Today about 70 % of all households are heated electrically. Electricity in the industrial sector is expected to increase at a rate close to 6 % for the next 5 years and close to 4 % over the next 20 years. Because of a forecasted sustained economic growth and the recent conclusion of a free trade agreement between Canada and the United States, this forecast will soon be revised upwards. Because of the importance of electric heating, peak demand is very sensitive to outside temperature. In order to somewhat control the increase in peak demand, Hydro-Quebec has been successfully promoting dual-energy heating systems.

45293 (LBL–26924) **Evaluation methods in competitive bidding for electric power.** Kahn, E.P.; Goldman, C.A.; Stoft, S.; Berman, D. Lawrence Berkeley Lab., CA (USA). Jun 1989. 103p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC03-76SF00098. Order Number DE89016571/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Competitive bidding for new electricity generation is a rapidly growing phenomenon. A number of utilities have completed auctions for long-term power contracts with private suppliers, and more are being proposed. Yet despite all of this activity, there has not been any systematic analysis of the design choices posed by this process. Are these procedures economic? What biases are built into the process? How are various objectives traded off against one another in the implementation of competitive bidding? In this report we undertake a systematic analysis of some of the competitive bidding procedures that have been used or are being proposed at the state level. We take no position on the larger political debate surrounding this process. These policy issues, raised principally by initiatives of the Federal Energy Regulatory Commission (FERC), address the scope and appropriateness of competitive bidding. 58 refs., 9 figs., 23 tabs.

45294 (ME–88) **Maritime Electric Co. Ltd. annual report, 1988.** Martec Ltd., Halifax, NS (Canada). 1988. 17p. (MICROLOG–89-02994). Available from Maritime Electric Co. Ltd., Confederation Court Mall, 134 Kent St., Charlottetown, PE, CAN C1A 7N2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Maritime Electric Company is a Canadian investor-owned electric utility based in Prince Edward Island. Established in 1918, the Company owns and operates a fully integrated system providing for the generation, transmission and distribution of electricity throughout the Island. Maritime Electric operates generating plants in Charlottetown and Borden, and has an equity interest in NB Power's unit in Dalhousie, New Brunswick. Its 4,100 km distribution system and 500 km transmission system are linked to the mainland power grid by two submarine cables between the Island and the province of New Brunswick. This report describes the Company's operations, power production and sales for the year, with relevant statistical information. Financial statements are also included.

45295 (NEI-SE–42) **Who owns the power ?.** Statens Energiverk, Stockholm (Sweden). 1 Mar 1989. 43p. (In Swedish). Order Number DE89914798/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The State, through the State Power Board, accounts for about half the yearly electricity production in Sweden. The remainder - c. 73 TWh - is produced by private and municipal enterprises. The report surveys the part of the electricity production that is not entirely owned by the State. The survey comprises hydro and thermal power plants, municipal combined power and district heating plants and industrial back-pressure plants. The smallest hydro-electric power plants and wind power plants, gas turbines or other power reserves are not included.

45296 (NLH–1988) **Newfoundland and Labrador Hydro annual report, 1988.** Newfoundland and Labrador Hydra, St. John's, NF (Canada). 1988. 33p. (MICROLOG–89-04110). Available from Newfoundland and Labrador Hydro, Philip Pl., Elizabeth Ave., St. John's, NF, CAN A1A 2X8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Newfoundland and Labrador Hydro group of companies provide electrical power and energy to the province and for export, through its electrical generation, transmission and distribution facilities. Most of the power on the island of Newfoundland is produced from hydroelectric stations, the reminder from thermal power plants. Operational services are also provided to the rural electrification program. In addition, the Hydro group engages in energy planning in order to meet future demand for electricity. In Labrador, the Churchill Falls Corporation generates hydroelectric power, mainly for export to Quebec, with the rest going to local domestic and industrial users. This report reviews the Hydro group's activities for the year, in the areas of energy supply and production, environmental concerns, operations, engineering, construction, employee relations, rates, corporate services, and finances. Financial statements are also included. 27 figs., 5 tabs.

45297 (OEB–HR-17) **Report of the [Ontario Energy] Board in the matter of a reference respecting Ontario Hydro, vol. 1.** Ontario Energy Board, Toronto, ON (Canada). 1988. 515p. (MICROLOG–89-03114). Available from Publications Ontario, 880 Bay St., 5th Floor, Toronto, ON, CAN M7A 1N8; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report was prepared by the Ontario Energy Board pursuant to Section 37 of the Ontario Energy Board Act, as a result of a request by Ontario Hydro to raise its average electricity wholesale rates by 5.5%. Details of the consequent public hearing are given in

the report, including the intervention of the Association of Major Power Consumers in Ontario, the Municipal Electric Association, the Consumers Association of Canada (Ontario Chapter), Energy Probe, and the Independent Power Producers of Ontario, among others. The report includes the Board's recommendations, some perspective and historical background, demand and supply considerations, the new rate structure proposed by Ontario Hydro, details of the hearings, and cost awards to the parties. The Board approved a rate increase of 5.8%. Appendices include the relevant legislation, transmittal letters and procedural orders, maps of Ontario Hydro's area of operation, Ontario Hydro's response to the recommendations, a summary of argument for each intervenor, and a glossary of terms. 8 tabs., 2 figs.

45298 (OH/RD–88-93-K) **Energy planning model enhancements.** Wang, L.; Ramani, N. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 30p. (MICROLOG–89-02573). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

One of the tools used at Ontario Hydro in the BESTOP (Bulk Electricity System Tactical Operating Plan) process is the FOMOD program which employs the Monte Carlo simulation technique for electric energy production planning. This report describes two proposed methods of estimating the confidence bounds on the simulation results. It also presents the results of an investigation on possible improvements to the generating unit model used in the simulation process of the FOMOD program. 7 refs., 4 figs., 7 tabs.

45299 (ORNL/CON–285) **Electric-utility energy-efficiency and load-management programs: Resources for the 1990s.** Hirst, E. Oak Ridge National Lab., TN (USA). Jun 1989. 45p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015688/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The primary purpose of this report is to suggest much larger and more active roles for utilities in acquiring energy-efficiency and load-management resources. Valuable utility actions include increased efforts to: Assess existing and new demand-side technologies; Test alternative ways to implement demand-side programs; Aggressively acquire energy and capacity resources through efficiency and load-management programs; Work with governments to support efficiency standards for new buildings, appliances, and other energy-using equipment; Develop innovative pricing mechanisms to modify load shapes and levels and to encourage participation in utility programs; Work with public utility commissions to update rate regulation so that utilities are rewarded for running demand-side management programs; Integrate planning for demand-side programs with planning for supply resources; and Incorporate the risk-reduction benefits of demand-side programs into resource planning. 66 refs., 7 figs., 5 tabs.

45300 (ORNL/CON–288) **Recent accomplishments of the US Department of Energy's Least-Cost Utility Planning program.** Berry, L.; Hirst, E. Oak Ridge National Lab., TN (USA). Aug 1989. 57p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015690/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Least-cost utility planning considers a broad array of energy resources, including conservation and load management programs, power plants (both utility- and nonutility-owned facilities), transmission and distribution options, and alternative pricing systems. Such planning can yield enormous benefits to utilities, state regulatory commissions and especially to consumers. These benefits include acquisition of resources that meet customer energy-service needs in ways that are low in cost, environmentally benign, and publicly acceptable. Such benefits occur because of the diversity of resources considered, public involvement in the planning process and cooperation between regulators and utilities. This report reviews the recent accomplishments of the US Department of Energy's Least-Cost Utility Planning program (DOE/LCUP). It focuses on projects completed in fiscal year 1989. The results of these projects are discussed and a bibliography of their publications is provided. 55 refs., 7 figs., 5 tabs.

45301 (SPC–1988) **SaskPower annual report, 1988.** Saskatchewan Power Corp., Regina, SK (Canada). 1988. 22p. (MICROLOG–89-02809). Available from Saskatchewan Power Corporation, 2025 Victoria Ave., Regina, SK, CAN S4P 0S1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

SaskPower is a provincially owned Crown Corporation, established in 1949 to provide electricity and natural gas to the residents of Saskatchewan. SaskPower's primary objective is to meet the natural gas and electrical energy needs of Saskatchewan residents in an economical, safe reliable, efficient and environmentally responsible manner. This service is to be provided at rates that cover all costs and contribute to short- and long-term financial health of the corporation. SaskPower's board of directors is appointed by the provincial government and represents a broad spectrum of Saskatchewan residents. This report presents relative production and consumption statistics relating to gas and electricity operations, as well as the years developments in management and service practices. Financial statements are also included.

45302 (TYOT-JULK–306) **Consumption of electricity on farms and means of eliminating consumption peaks.** Maunu, T. Tyotehoseuran Julkaisuja, Helsinki (Finland). 1989. 95p. (In Finnish). Order Number DE89787745/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The purpose of this study was to determine power consumption and consumption peaks on farms differing from one another in terms of production and size. In addition, the aim was to find out wheather power consumption peaks on farms could be evened ou either by technical means or by changes in usage. The study also looked into possibilities on farms of benefiting from differences in electricity rates during different times of the day and during different seasons of the year. A mail questionnaire was carried out to determine the number of electrical appliances used on farms. The questionnaire was sent out to 1087 farms and 591 utilizable responses were obtained. The mail questionnaire was supplemented by interviewing a total of 60 farmers on the spot. The interviews were aimed at determining the times of day when certain appliances were used and the way in which people are accustomed to use electricity. Farms raising pigs were the biggest consumers of electricity. Second in order were poultry and dairy farms. Farms specialising in grain production consumed the least electricity. The annual power consumption on farms without electrical heating was on the average 10946 kWh. The average for all farms was 12561 kWh. Consumption of electricity on farms increased as production (number of animals or area under cereal crops) increased. This was accompanied by variation in power consumption between farms. The daily consumption peaks on dairy farms occurred during morning and evening milking times. On farms raising grain crops power consumption remained fairly even throughout the day. Operating the mill causes 1-2 major consumption peaks per week lasting 1-2 hours at a time. Over the year, the power consumption peaks on farms coincide with the drying of grain in the autumn and chipping of fuel wood and drying of hay in the summer.

45303 (UCID–19227-88) **US energy flow—1988.** Borg, I.Y.; Briggs, C.K. Lawrence Livermore National Lab., CA (USA). Jun 1989. 15p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-7405-ENG-48. Order Number DE89015186/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Trends in energy supply and use that were established in the mid-80's continued into 1988. Oil remains the largest single source of energy for the country. Overall energy consumption increased in all end-use sectors; however the greatest growth occurred in residential/commercial sectors; electrical demand increased three percent; the use of coal particularly for electrical generation increased for the eighth year; domestic oil production declined and oil imports increased; and increases in use of transportation fuels more than offset fuel economies effected by fuel standards imposed on new passenger cars since 1978. Most of the trends are a reflection on the decline in cost of all fossil fuels led by the precipitous fall of crude oil prices in the spring of 1986. During 1988 natural gas prices remained depressed and increased use would have been larger in central and northeastern sectors of the country if pipelines

from western US and Canada could have handled larger volumes. 13 refs., 7 figs., 2 tabs.

2980 Consumption and Utilization

Refer also to citation(s) 45229, 45238

45304 (GRS–592) **Stabilization of the energy consumption in Norway. Energy and environment.** Dale, E.; Kalgraf, K.; Owens, J.; Raaholt, M.; Tank-Nielsen, C. Gruppen for Ressursstudier, Oslo (Norway). Nov 1984. 83p. (In Norwegian). Order Number DE89914758/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report concerns the stabilization of the energy consumption in Norway. In this connection, two main aspects are discussed, e.g. the correlation between the energy consumption and environmental effects. The aspects deal with the damage to the nature caused by the water-power development, and the changed condition of the air quality/heat balance from the combustion of the various energy carriers. Following topics are discussed: Environmental effects from the production and use of energy; future environmental effects from the stabilization and changed energy carrier division; measures to reduce the environmental damages per energy unit; comparison of environmental effects. In the appendix, the environmental effects from the various energy carriers both on the regional and global level are discussed. 13 figures, 12 tables, 59 references.

2990 Unconventional Sources and Power Generation

Refer also to citation(s) 44863, 44951, 44952, 44953, 44954, 44975, 45208, 45210, 45221, 46079

45305 (EFG–1988) **Prince Edward Island Energy Corporation annual report, 1987-1988.** Department of Energy and Forestry, Charlottetown, PE (Canada). 1988. 27p. (MICROLOG–89-02765). Available from Prince Edward Island. Dept. of Energy and Forestry, Shaw Bldg., 105 Rochford St., PO Box 2000, Charlottetown, PE, CAN C1A 7N8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The objectives of the Energy Corporation are to develop and promote energy systems on an economic and efficient basis and to coordinate all government programs in the establishment and application of energy systems in the province. The Corporation operates within the general framework of provincial energy policy which is the responsibility of the Minister of Energy & Forestry. This report describes the Corporation's activities during the year and includes a summary of demonstation programs, research projects, and successful energy system applications. These have included the heating of provincially owned buildings with wood chip fuel, energy-from-waste plants, wind turbines, district heating systems, and various programs to promote the use of wood fuels. Financial statements are also included.

45306 (ETDE/CA-MS–1978) **Canadian renewable energy prospects.** Swain, H. Department of Energy, Mines and Resources, Ottawa, ON (Canada). Renewable Energy Resources Branch. 1978. 32p. (CE–02737). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This paper presents the prospects for renewable energy use in Canada. The 1978 market is examined followed by a discussion of nine renewable options: solar space and water heating, hard solar (solar thermoelectric conversion and photovoltaics) , forest biomass and peat, agricultural biomass, wind, tidal power, ocean thermal gradients, goethermal energy, and traditional hydroelectricity. There is a short discusssion of the roles for government in encouraging renewable development. 35 refs., 3 figs., 2 tabs.

45307 (NBNRE–8810, pp. 29) **Wood energy in perspective.** Strange, D.L.P. (Energy, Mines and Resources Canada). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper provides an overview of the present and future of wood as an energy source in Canada. Presently, renewable energy accounts for almost 7% of total primary energy requirements. Round wood, wood waste, and as spent pulping liquor in the pulp and paper industry are the main sources. The history of government initiatives in the field of renewable energies is recalled. It is estimated that there are some 112 M ton/y of biomass available, of which 50 M ton/y are available at under $12/bbl of oil equivalent, which is equal to about $30/delivered ton. Bioenergy infrastructure and the economic feasibility of bioenergy are discussed. In total, by the year 2005, there is the potential to increase the use of bioenergy by 196 P J; this almost doubles the current contrbution from round wood in the residential sector and from forest-biomass, if one excludes the 252 P J currently coming from the use of spent pulping liquor. The future of the energy prices and the environmental advantages of bioenergy are discussed. Alcohol has merits for use as a lead replacement octane enhancer. Although, currently, the economics are not attractive, there is the potential of replacing lead with alcohol generated from wood. The new Energy Efficiency and Diversity Initiative of the Canadian Minister of Energy, Mines and Resources is presented. 6 figs., 4 tabs.

45308 (NBNRE–8810, pp. 15) **Financing options for energy projects.** Dean, J.R. (The ADI Group of Companies). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The main investment criterium for public bodies when considering a wood-fired plant is the difference between expected annual savings and the cost-of debt. For private companies, the investment criteria are more complex because of income tax costs and of the need to show a return on the shareholders equity investment. The paper discusses off-balance sheet financing for energy projects, special tax treatment in Canada for conservation and removable energy equipment (especially wood-fired power stations with or without cogeneration), and the associated amortization rules. These concepts are illustrated on the case of a new wood-fired boiler for 3 applications: a hospital, a university and a manufacturer. The paper discusses 2 forms of off-balance sheet financing: capital lease and operating lease. The development strategy for wood-fired plants is discussed as an example. In summary, there are a multitude of ways to finance a project today, ranging from simple debt or mortage financing to the more sophisticated capital lease and operating lease arrangements. Each approach has its positive and negative aspects and deciding what is best for each particular application requires a sound knowledge of both the accounting and tax implications.

45309 (NBNRE–8810, pp. 18) **Forest management implications of wood energy.** Baskerville, G. (Univ. of New Brunswick, NB, Canada). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper deals with the contributions forest management can make to the future quality of forests in New Brunswick. The effects of forest management would be the following. The amount of low quality biomass available for wood energy use will not be increased, but will likely be decreased over time. The amount of round wood available for raw materials like pulp and studwood would be increased gradually over time. The rate of decline in the availability of sawlog quality material would be slowed, and eventually turned

around. There would be a general shift towards the production of greater quality wood in the forest. Finally, there is no doubt that a balance could be reached by which both round wood proudction and wood energy would be sustainable in a manner that would maintain overall quality in the forest with time. This balance would not maximise the production of either wood energy, or high quality material. New Brunswick can blunder into the default future and extend historic high-grading to harvesting for wood energy or by dint of hard work and real forest management, make of wood energy a powerful tool for rebuilding quality in the forest. Wood energy offers an opportunity to accelerate the introduction of forest management, but dedication is required on the part of New Brunswickers.

45310 (NBNRE–8810, pp. 13) **Renewable energy. Offspring of OPEC.** Reisen, A.E. (Canadian Energy Research Inst.). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper describes the Canadian Energy Research Institute (CERI), the place of renewably energy in the world energy market and in the Canadian market, and provides the results of a recently released study of the world oil market. The development of alternative energy sources and their speed of adoption over the last 15 years have been closely tied to the power of the Organization of Petroleum Exporting Countries (OPEC) in the world oil market and the dramatic prices increases in world oil over the 1970s and early 1980s. An analytical framework was developed based on the underlying fundamental characteristics of the oil market, to allow for the analysis of, among others, the following questions: in the event of a collapse of the OPEC cartel and of the development of a competitive world oil market, what would be the resulting floor price for crude oil, in what areas of the world would oil production be affected, and what would be the likely duration of this competitive floor price. Three different scenarios are presented and their implications for the various energy sectors are discussed. The three main conclusions are that the world oil market will respond to market uncertainties over the short term, but will follow a stable, upward growth path over the long term; that those involved in the energy market should focus more attention on the fundamentals of the oil market; and that virtually all of the short-term price risk associated with the oil market stands on the downwards side. It is important to the energy future of Canada that policy makers recognize and support energy savings and alternative energy sources, and not be overly swayed by the economic development benefits of large-scale energy projects. 7 figs.

45311 (PB–89-203525/XAB) **Case studies of waste-to-energy facilities. Final report.** Sachs, M.M.; Dreher, D. Northeastern Illinois Planning Commission, Chicago, IL (USA). May 1989. 65p. Available from NTIS, PC A04/MF A01.

This report examines the planning and establishment of three waste-to-energy facilities in Lakeland, Florida; Rome, New York; and Millbury, Massachusetts. The complex issues and problems associated with project finance, the local politics, and public involvement and information are described and discussed for each facility. The report illustrates many of the obstacles to development of waste-to-energy facilities and suggests alternative approaches to facility development. Factors leading to the selection of energy recovery over other waste-management alternatives are discussed, as well as the degree to which recycling and landfilling are incorporated into facility operations.

30 DIRECT ENERGY CONVERSION

3001 MHD Generators

45312 (DOE/ET/10815–128) **The magnetohydrodynamics coal-fired flow facility: Technical progress report, January 1, 1989–March 31, 1989.** Tennessee Univ., Tullahoma, TN (USA). Space Inst. Aug 1989. 54p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC02-79ET10815. (UTSI–89-03). Order Number DE89016747/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

UTSI reports on the development of the technology for the Steam Bottoming Plant of the Combined Cycle MHD Steam Power Plant. Technical efforts are summarized on modeling and measurement of the heat flux and gasdynamics in the radiant furnace. Work is also reported on rebuilding the superheater test module to provide more testing flexibility and increased tube spacing in the convective heat transfer components. Test results analyzing the particulate loading in the ducts leading to the entrance of the ESP and baghouse to determine level of stratification are included. Data that was taken during previous tests to determine the required soot blowing parameters is analyzed in this report. Plans for testing of corrosion probes and ash deposition probes in future tests are discussed. Plans for further evaluation of ceramic tube materials for application to a high temperature recuperative air heater are summarized. Results of applications of advanced diagnostics equipment are included. Maintenance and modification work on the DOE Coal Fired Flow Facility (CFFF) is covered. Finally, ongoing studies and analyses as well as efforts in improving chemistry laboratory analyses are summarized. 8 figs., 4 tabs.

45313 (DOE/PC/90274–T4) **MHD integrated topping cycle project: Fifth quarterly technical progress report, August 1, 1988–October 31, 1988.** TRW, Inc., Redondo Beach, CA (USA). Applied Technology Div. Apr 1989. 156p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC22-87PC90274. (MHD-ITC–89-126). Order Number DE89015997/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

The scope of work covered by this quarterly report encompasses prototypical combustor and channel design studies, design support engineering for the prototypical hardware, and 50 MW_t power train testing data analysis. A new TRW design concept was developed for cooling the prototypical combustor which utilizes modular cooling panels. The new design offers improved maintainability and scalability over the originally proposed design. Avco performed design analyses to define aspect ratios for the prototypical channel. The operating conditions for the channel are being determined in conjunction with TRW. Fabrication of the prototypical current controls continued. Avco continued development testing in the Mark VII facility to provide design data for the prototypical 1A4 channel. Testing focused on evaluating methods for obtaining transverse conductivity measurements and on the effects of cathode slag shorting on generator performance. Westinghouse completed detailed designs for the breadboard power consolidation circuitry for the Mark VII generator. Fabrication and performance verification testing of these circuits is well underway. The data acquisition and monitor system for the bread-board consolidation circuits was also designed. The 50 MW_t workhorse power train was tested under conditions of 100% slag carryover. Results showed only a slight decrease in power output from the nominal 50% carryover baseline. Analyses indicate that performance is much more sensitive to slag carryover in the zero to 30% range. 4 refs., 78 figs., 14 tabs.

3003 Thermoelectric Generators

45314 (AD-A–207769/1/XAB) **Iron disilicide thermoelectric generator. Final report, 1 August 1988-15 April 1989.** Schlicklin, P.M.; Stockholm, J.G. European Research Office, London (UK). 15 Apr 1989. 45p. Available from NTIS, PC A03/MF A01.

A small prototype was built enabling heat flux and electrical measurements. It allows the characterization of iron disilicide couples manufactured by the University of Karlsruhe (Federal Republic of Germany). The results on 2 couples do not confirm published data, the manufacturing of the material appears to lead to considerable quality dispersion. Succinct sturdiness tests are reported. Using the characterization results, a unit is dimensioned to produce between 10 and 15 watts.

3005 Fuel Cells

Refer also to citation(s) 45492

45315 (ECN–89-128) **Conductive $LiFe(Mg)O_2$ ceramics for molten carbonate fuel cells.** Huijsmans, J.P.P.; Van der Molen, S.B. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1989. 7p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the ECerS-conference, Maastricht, Netherlands, 19-23 June 1989.

$LiFe_{0.97}Mg_{0.03}O_2$ ($LFMg_3$) is tested at ECN as an alternative cathode material for molten carbonate fuel cells (MCFC). To obtain the required electrode microstructure, i.e. microporous, catalytically active, small agglomerates (3-8 micron) and large open gas distribution pores (10 micron), various amounts of pure carbon are mixed as a pore former with $LFMg_3$ powder. Cell tests indicate that the presence of molten carbonate positively influences the conductivity characteristics of $LFMg_3$. Polarization losses are high, due to the lack of small (< 1 micron) pores in the electrode microstructure. 2 figs., 6 refs., 1 tab.

45316 (ECN–89-129) **Membrane-based thin layer SOFC components.** Huijsmans, J.P.P.; Van der Molen, S.B.; Siewers, E.J. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1989. 7p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

Presented at the ECerS-conference, Maastricht, Netherlands, 19-23 June 1989.

A solid oxide fuel cell (SOFC) air-electrode of Sr-doped $LaMnO_3$ (SLM) is developed at ECN. Initially, it will be supported by porous alumina. It will act as an electronically conductive, oxide ceramic substrate for a thin ion conducting electrolyte structure of Y_2O_3-stabilized zirconia (YSZ). The electrolyte structure will be deposited by (E)CVD techniques to be developed by University of Twente. SLM powder is made by a citrate synthesis route. The fabrication of Al_2O_3 support material and the application of a thin layer of SLM on this support is based on production techniques developed in the past by ECN for three-layer alumina membranes. 3 figs., 5 refs., 1 tab.

45317 (PB–89-205082/XAB) **Novel fluorinated acids for phosphoric acid fuel cells. Annual report, Aril 1987-March 1988.** DesMarteau, D.D. Clemson Univ., SC (USA). Dept. of Chemistry. Apr 1989. 22p. Available from NTIS, PC A03/MF A01.

See also PB–87-235651.

A program for the synthesis of strong acids of the type $(RfSO_2)_2NH$ and $(R_fSO_2)_2CH_2$ was continued and extended to polyfunctional derivatives. A series of difunctional carbon acids was prepared and intermediates in reactions were isolated and characterized. Several new compounds were prepared. Structural characterization of these novel carbon and nitrogen acids was pursued by x-ray diffraction providing clear evidence for the extensive charge delocalization from nitrogen and carbon onto the sulfonyl oxygens. This feature is clearly responsible for the remarkable acidity of these compounds wherein the ionization of the proton leads to a highly stabilized anion. Five crystal structures were determined.

45318 Method and apparatus for assembling solid oxide fuel cells. Szreders, B.E.; Campanella, N. To Dept. of Energy, Washington, DC. USA Patent 4,827,606. 9 May 1989. Filed date 11 May 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A plurality of jet air tubes are supported and maintained in a spaced matrix array by a positioning/insertion assembly for insertion in respective tubes of a solid oxide fuel cell (SOFC) in the assembly of an SOFC module. The positioning/insertion assembly includes a plurality of generally planar, elongated, linear vanes which are pivotally mounted at each end thereof to a support frame. The vanes, which each include a plurality of spaced slots along the facing edges thereof, may be pivotally displaced from a generally vertical orientation, wherein each jet air tube is positioned within and engaged by the aligned slots of a plurality of paired upper and lower vanes to facilitate their insertion in respective aligned SOFC tubes arranged in a matrix array, to an inclined orientation, wherein the jet air tubes may be removed from the positioning/insertion assembly after being inserted in the SOFC tubes. A rectangular compression assembly of adjustable size is adapted to receive and squeeze a matrix of SOFC tubes so as to compress the inter-tube nickel felt conductive pads which provide series/parallel electrical connection between adjacent SOFCs, with a series of increasingly larger retainer frames used to maintain larger matrices of SOFC tubes in position. Expansion of the SOFC module housing at the high operating temperatures of the SOFC is accommodated by conductive, flexible, resilient expansion, connector bars which provide support and electrical coupling at the top and bottom of the SOFC module housing.

45319 Manifold, bus support and coupling arrangement for solid oxide fuel cells. Parry, G.W. To Dept. of Energy, Washington, DC. USA Patent 4,824,742. 25 Apr 1989. Filed date 21 Apr 1988. 14p. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

Individual, tubular solid oxide fuel cells (SOFCs) are assembled into bundles called a module within a housing, with a plurality of modules arranged end-to-end in a linear, stacked configuration called a string. A common set of piping comprised of a suitable high temperature resistant material (1) provides fuel and air to each module housing, (2) serves as electrically conducting buses, and (3) provides structural support for a string of SOFC modules. The piping thus forms a manifold for directing fuel and air to each module in a string and makes electrical contact with the module's anode and cathode to conduct the DC power generated by the SOFC. The piping also provides structural support for each individual module and maintains each string of modules as a structurally integral unit for ensuring high strength in a large 3-dimensional array of SOFC modules. Ceramic collars are used to connect fuel and air inlet piping to each of the electrodes in an SOFC module and provide (1) electrical insulation for the current carrying bus bars and gas manifolds, (2) damping for the fuel and air inlet piping, and (3) proper spacing between the fuel and air inlet piping to prevent contact between these tubes and possible damage to the SOFC.

32 ENERGY CONSERVATION, CONSUMPTION, AND UTILIZATION

Refer also to citation(s) 44864, 44866, 44986, 45190, 45191

45320 (CCA–1989) **Consumer and Corporate Affairs Canada Consumer Energy Conservation Research Program summary of achievements.** Consumer and Corporate Affairs Canada, Ottawa, ON (Canada). [1989]. vp. (CE–02738). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report is an overview of surveys conducted in Canada by the Ministry of Consumer and Corporate Affairs on energy conservation activities in the residential sector and other sectors. It deals with information dissemination strategies, with the attitudes and perceptions of consumers, with residential fuel conversion, with the energy labelling of electrical appliances, with energy conservation and retrofit in the house, with personal transportation means, and with energy conservation in the commercial sector and other sectors. The report also summarizes surveys or other studies completed for the Ministry in the field of energy conservation. 41 refs.

3201 Buildings

Refer also to citation(s) 45186, 45192, 45193, 45196, 45199, 45211, 45215, 45219, 45220, 45431, 45432, 45753, 45874, 46069

45321 (AA/T–435U525) **Development and testing of combination domestic appliances. Stage 1 - Feasibility.** Allen, G.; Kani, M. Allen Associates, Toronto, ON (Canada). 1987. 116p. (CE–02732). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Based upon a fundamental investigation into combined functions for domestic end uses, a number of conceptual combined appliances were identified for further analysis and computer simulation. The combinations include: heat recovery dryers (heat recovery vent, or heat pump); a space heating/cooling/domestic hot water (DHW) heating ventilation unit; refrigerators that heat hot water; a

runaround heat pump loop that provides refrigeration/ventilation/cooling/DHW heating; and a fully integrated mechanical system for ventilation/space heating/cooling/DHW heating incorporating ice-based thermal storage. The thermal performance and resulting cost-effectiveness was studied to identify the most viable equipment. Appliance and heat-ventilating-air conditioning manufacturers were surveyed to assess the marketability of these combined appliances. 27 refs., 20 figs., 22 tabs.

45322 (BFR-R-41-1989) **LIGHTWEIGHT 85. Energy and resource economic detached houses with low housing expenses.** Carlson, P.O.; Blomsterberg, Aa. Swedish Council for Building Research, Stockholm (Sweden). Dec 1987. 225p. (In Swedish). Order Number DE89914789/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The object of this project was to design, build and, over a period of 2 years, to evaluate an energy efficient single family house with low annual cost, adapted to the requirements of the eighties. By combining known technology and some new technical solutions in a well insulated and airtight single family house so as to produce an advantageous overall design, 18 practically identical detached houses were built in 1984 in Taeby Municipality. It has been possible to meet the goal of reducing construction costs by ca 10% compared with houses of conventional design. At the same time, the requirement for bought energy is about 40% lower than necessitated by the requirements in the Swedish Building Code SBN 1980. Architecturally, the houses have been designed as detached 1 1/2 storey buildings with a floor area of 118 m^2. From the point of view of energy, an important advantage of a 1 1/12 storey single family house is that the total wall and roof area is small in relation to the floor area. On the basis of experiences gained from this project, future low energy and economic single family houses should be * well insulated, with the level of thermal insulation at least equivalent to that specified by the ELAK enquiry, * airtight, with a maximum of 1 ach at 50 Pa, * provided with an effective and energy efficient ventilation system, * constructed using lightweight construction technology, * to the greatest possible extent, prefabricated in the dry in the factory, and the time spent on the site to the erection of a watertight roof should be as short as possible, * provided with a simple heating system, * equipped with installations efficient in their use of energy and water, * equipped with energy efficient household appliances, * provided with a user friendly set of instructions for operation and maintenance. (With 54 refs.).

45323 (BFR-R-42-1989) **Worthwhile knowledge about waterborne heat.** Haeggbom, S.; Nylund, P.O. Swedish Council for Building Research, Stockholm (Sweden). 30 Jun 1987. 78p. (In Swedish). Order Number DE89914790/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report describes connections between radiator size, pipe dimensions, flow rates, pump pressures, natural circulation forces and flow resistance of components. C. 40 diagrams illustrate component properties, temperatures, flow rates and heat transfer for a heating system in an apartment building.

45324 (BLRL-8808) **A follow up study of the Retrofit Design Competition.** Baseline Market Research Ltd., Fredericton, NB (Canada). 1988. 40p. (MICROLOG-89-02878). Available from New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

During the first quarter of 1988, the federal and provincial governments, through the Canada/New Brunswick Conservation and Alternative Energy Agreement, sponsored a retrofit design competition for completed energy efficient residential retrofit projects in New Brunswick. The purpose of this study is to determine why people chose not to enter the competition. Baseline Market Research Ltd. was provided with a list of 98 names of people who requested information about the competition but did not subsequently submit an entry. The research methodology is described. In conclusion, it appears that many of the non-entrants to the competition misunderstood its general purpose, while others underestimated the complexity of the entrance requirements. It was an issue of time and stringent demands that discouraged many, who might have been eligible, from submitting an entry. In terms of improvements for future design competitions, non-entrants suggested longer time frames, less detailed submission procedures, as well as allowing the submission of planned renovation projects. The guidelines of the retrofit design competition are recalled as an annex to the report.

45325 (CONF-890815-23) **Dynamic charateristics concerned in the design of a free-piston Stirling engine/magnetic coupling/compressor system.** Chen, G. Oak Ridge National Lab., TN (USA); Sunpower, Inc., Athens, OH (USA). 1989. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 24. intersociety energy conversion engineering conference; 6-11 Aug 1989. Order Number DE89015981/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

In a free-piston Stirling engine-driven heat pump, the engine power must be controlled to follow the compressor load. An axial magnetic coupling connecting the engine power piston and compressor piston acts like a nonlinear spring. The dynamic characteristics associated with the system design for this type of heat pump are considered in this paper. System concepts are described in terms of the engine power-load matching, system tuning, and identifying the load on the magnetic coupling. 6 refs., 9 figs., 2 tabs.

45326 (CONF-890976-1) **A model to predict heat flows and temperatures in roofs.** Wilkes, K.E. Oak Ridge National Lab., TN (USA). [1989]. 21p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From International symposium on mathematical modeling of roof systems; 15-16 Sep 1989. Order Number DE89007817/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Models play an important role in the operation of the Roof Research Center at Oak Ridge National Laboratory (ORNL). They increase the efficiency of costly experimentation by guiding the placement of sensors, identifying critical experiments, and extrapolating the results of experimental data to conditions other than those which were tested. Models are essential to developing an understanding of the complex interactions of the thermal, moisture, and mechanical behaviors of roofs. This paper gives a description of the model named STAR (Simplified Transient Analysis of Roofs) that has been developed at ORNL for predicting the heat flows and temperatures within roof systems. The model has several advantages. It is flexible in that it can handle multiple layers of materials having arbitrary thermal conductivities, specific heats, and densities. It can be used to analyze experimental data where boundary temperature data are available, as well as hypothetical cases where only weather data are available. One of the model's main advantages is its availability. 5 refs., 8 figs., 3 tabs.

45327 (CONF-8504343-, pp. 53-59) **Screw condensers in high-temperature heat pumps - their scope and limits of application.** Engelhard, J. (M.A.N. Technologie G.m.b.H., Muenchen (Germany, F.R.)). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies.* Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Screw-type condensers are used successfully in heat pumps (fluid R22 or R12) for building heating systems. The condensation temperatures achievable with different condenser types range between 57 and 85^{0}C. Material selection criteria are given in a table (critical temperature, condensation temperature, decay rate at 150^{0}C after 2 years). Lubricant supply of the screw condenser (circuit diagram) is reported for standard heat pumps and extreme conditions. Data are provided on volumetric efficiency in dependance from evaporation temperature (characteristics field) and on variables influencing driving power (pressure/temperature, condenser, speed, fluid type). The maximum admissible operating pressure constitutes the application limit of the screw condenser. (HWJ).

45328 (CONF-8710493-) **Control of space HVAC systems. Proceedings.** GMA-Bericht. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. 155p. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

This GMA report presents automation concepts for the control of space HVAC systems using new support methods and means like

computer technology and digital simulation methods while considering control problems associated with the application of such methods and means. Both technical and economic aspects are discussed. New findings also concern the structurization and design of control systems, modelling of component and system behaviour for scale-up and simulation of plants. Each of the 10 papers was abstracted for entry into the data base. (HW).

45329 (CONF-8710493–, pp. 1-18) **Specification of air-conditioning control systems.** Schaefer, H. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Although the standard performance specification sheet StLB 070 has been devised expressly for the control of space HVAC and sanitary systems, pertinent performance descriptions are preferably based on StLB 067 - Zentrale Leittechnik fuer betriebstechnische Anlagen. This is mostly attributable to the new but already established DDC technology and new control strategies. The specification of performance characteristics also provides an overview on today's state of the art of air conditioning from a planner's point of view. (orig.).

45330 (CONF-8710493–, pp. 19-32) **Analog and digital appliance technology for the control and monitoring of space HVAC systems.** Gyoeri, M. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Both analog and digital devices are expected to meet the required control functions. The analog control device meets this function by way of a complicated circuitry and wiring technology of varying sophistication. In the digital control by a preprogrammed microprocessor. Digital technology allows to use the copied programme in different devices. Any change in the control of a system can be implemented and met by a programme change in digital technology. In analog technology, this change involves a change in wiring. (orig./HW).

45331 (CONF-8710493–, pp. 33-49) **Strategies for humidity control.** Baumgarth, S. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Humidity and temperature control in air-conditioning systems mostly involves coupled closed-loop control circuits. The author discusses their uncoupling and resulting consequences as well as energy-optimized control of recirculation air flaps or enthalpy recovering systems (h-x control) in detail. Special reference is made of the application of the DDC technology and its scope, limits and preconditions. In conclusions, the author presents pertinent measurement results. (orig.).

45332 (CONF-8710493–, pp. 51-60) **Modelling of air-conditioned and heated spaces.** Moehl, U. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

A space represents a complex system involving numerous components, manipulated variables and disturbances which need to be described if dynamic behaviour of space air is to be determined. A justifiable amount of simulation input is determined by the application of adjusted modelling of the individual components. The determination of natural air exchange in heated spaces and of space-air flow in air-conditioned space are a primary source of uncertainties. (orig.).

45333 (CONF-8710493–, pp. 61-79) **Day-period and year-period simulation for an assessment of control and energy systems.** Jahn, A. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Computer simulation is gaining in practical importance in space HVAC technology. The author reports on simulation procedures and modelling while showing the success of computer simulation achieved to-date and commenting on different computer applications in space HVAC technology. The conditions of the software market in space HVAC technology require to enhance the profitability and service life of software developments. The author discusses their approaches and objectives under keywords like compatibility and portability, convergence of today's software islands, software tools, graphics orientation, simulation core system. (orig.).

45334 (CONF-8710493–, pp. 81-96) **System simulation methods.** Braun, H. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Advanced digital simulation technology is an important tool in research and development though not in practised engineering although its beneficial application is quite foreseeable in business economics terms. This situation may be attributed both to the complexity of available simulation software which is too high, and to the unwillingness of practising engineers to try and come to grips with this subject. Hence, the author intends to provide on introduction to the problems of digital simulation and to explain importants terms. (orig.).

45335 (CONF-8710493–, pp. 117-131) **Modelling and control of crossflow heat exchangers.** Wiening, W. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Cross-flow heat exchangers are used in space HVAC systems to cool and heat air. Varying operating conditions and the nonlinear exchange behaviour of heat exchangers often result in an extremely difficult control of air outlet temperature or air outlet humidity. Hence, mathematical models were developed which can be used both for the design of control circuits and the testing of control systems. A specific non-linear model was designed for the testing of control systems which allows digital simulation of the nonlinear dynamic exchange behaviour across the total operating-point range of cross-flow heat exchangers. Experimental studies confirmed both the mathematical models and the theoretical results obtained for the control of cross-flow heat exchangers. (orig.).

45336 (CONF-8710493–, pp. 133-145) **Problems of measurement data acquisition and their effects on control.** Kopp, H. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Functional control using microprocessors needs to be based on a mandatory input of all specified data of the system and its components and on the correct acquisition of measurement data. However, when comparing this highly developed control technology with the one available on site in real life, you cannot help feeling thrown back into 'the Dark Ages'. Planning of plants and systems lacks suitable working documents and, as a result, also rules which have been recognized in metrology based on experience and respect. The result is that faults and errors are looked for in the wrong place, for instance, in programming. Selected examples of pressure and temperature measurement are used to show where

problems occur which, in the final analysis, result in the acquisition of false or seemingly false measurement data. (orig.).

45337 (CONF-8710493–, pp. 147-157) **Controller optimization using practice-oriented adaptation procedures.** Linzenkirchner, E.; Preuss, H.P.; Kirchberg, K.H. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Rising energy cost and quality demands call for an enhanced quality of control systems and, as a result, for an optimization of the controllers used. Conventional optimization requires specialized staff for commissioning and substantial input of time. Application of microcomputer-based tools allows a wide application of advanced procedures for automatic adaptation of controllers. A practice-oriented implementation allows greater simplicity in the handling of these methods which otherwise could be assessed by experts only, and enables to reduce commissioning input. (orig.).

45338 (DOE/CE/30806–T1) **Design tool evaluation: Benchmark test cases: Task 8, Passive and hybrid solar low energy buildings: Technical report.** Bloomfield, D. (ed.). Architectural Energy Corp., Boulder, CO (USA); Building Research Establishment, Watford (UK). May 1989. 124p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-84CE30806. Order Number DE89016319/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; GPO Dep.

This report documents the simulation work conducted by the participants in an IEA Task VIII working group on Design Tool Evaluation. The objective of the working group was to investigate the practicality of producing a series of references, or benchmark test cases, which could be used as part of a rational process for choosing a thermal design tool for residential buildings. Target ranges for annual loads, annual maximum and minimum temperatures and peak loads were obtained using simulation models. These test the ability of design tools to model thermal mass, direct gain windows, overhangs, internally generated heat, and dead-band and set-back thermostat control strategies.

45339 (DOE/CE/30806–T4) **Design guidelines for energy efficient passive solar homes: Design information booklet No. 3.** Architectural Energy Corp., Westminster, CO (USA). Aug 1986. 71p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-84CE30806. Order Number DE89016010/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The guidelines discussed in this booklet represent the kinds of energy design issues that typically arise during the early phases of design. The guidelines should be seen as a starting point for developing a new house design or as the basis of comparison when evaluating and modifying an existing home design. The guidelines, if followed, will result in balanced hearing and cooling season performance, year around comfort and low energy costs. The positive or negative impact of varying from the guidelines is illustrated by means of flexibility graphs (parameter sensitivity curves) and energy saving combination tables. For energy saving design features not addressed by these guidelines, it will be necessary to assess their performance with an appropriate energy analysis tool.

45340 (DOE/CE/30806–T6) **Residential energy design guidelines development methodology: [Final report].** Architectural Energy Corp., Westminster, CO (USA). Aug 1986. 120p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-84CE30806. Order Number DE89016012/JAW. Available from NTIS, PC A06/MF A01 - OSTI.

The report is organized into two major chapters. Chapter 1.0 provides an overview of the technical basis of the design guideline development methodology. Our approach to climate analysis and season definition is described. Building energy analysis, using simulation and generalized energy balance equations, is discussed. The use of Generalized Heat Balance Equations for heating and cooling performance calculation is a key element in the methodology. The economic analysis approach is also presented. Finally, the use of graphic display as an integral part of the design guidelines development process is discussed. Graphic representation of a large number of energy and economic calculations enables visual inspection and interpretation to be used as a primary means for determining the recommended guideline levels for energy conservation and passive solar measures. Chapter 2.0 presents an overview of the approach employed to generate the design guidelines and describes a step by step procedure for producing the design guidelines. All of the relevant energy and economic equations are presented and described. 9 refs.

45341 (DOE/CE/30806–T7) **Residential energy design guidelines development methodology: Technical support document: Supplement.** Architectural Energy Corp., Boulder, CO (USA). May 1989. 100p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-84CE30806. Order Number DE89016013/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report supplements the Technical Support Document: Residential Energy Design Guidelines Development Methodology prepared by Architectural Energy Corporation in August 1986. It documents the refinements and improvements made in the overall methodology and illustrates its application to three cities representing diverse heating and cooling seasons. General conclusions and recommendations are made relative to issues influencing residential energy design guidelines development and to results from applying a design guidelines development methodology in three locations. The reader is encouraged to obtain and read the original technical support document as a basis for understanding the refinements and improvements made to the methodology. 21 refs.

45342 (DOE/CE/30806–T8) **Design tool selection and use: Design information booklet No. 4.** Anderson, D.L.; Blum, S.; Holtz, M.J. Architectural Energy Corp., Boulder, CO (USA); International Planning Associates, Beltsville, MD (USA); Burt, Hill, Kosar, Rittlemann, and Associates, Butler, PA (USA). Dec 1988. 50p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-84CE30806;AC03-87SF16667. Order Number DE89016014/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this booklet is to give the building designer a framework for selecting energy design tools. In that selection process, the questions that potential tool users ask vendors about design tools are important; equally important are the questions tool users should ask themselves about their needs and expectations regarding design tools. This booklet focuses on three topics: how design tools can assist decision-making at each phase in the design process: how design tool users can evaluate their specific needs and which design tool (or tools) can best meet those needs; and how design tool users can effectively "shop" for design tools by comparing the characteristics of various tools and asking the right questions to make an informed choice. 7 refs.

45343 (DOE/CE/30806–T9) **International Energy Agency (IEA) Task VIII passive and hybrid solar low energy buildings: Residential design-build projects: Archetype/Santa Fe development project summary.** Frey, D.J.; Gregerson, J.M. Architectural Energy Corp., Boulder, CO (USA). May 1989. 169p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-84CE30806. Order Number DE89016015/JAW. Available from NTIS, PC A08/MF A01 - OSTI.

Included in this report are a description of the building, significant steps in the design process, an overview of the monitoring process, and results from the thermal monitoring. Also included are the responses provided by the owner/occupant to questions on the "Class C" questionnaire. This is the same questionnaire that was used in the Department of Energy's Class C passive building performance evaluation program in the early 1980s. 9 refs., 8 tabs.

45344 (EFI-TR–3547) **Load development in 129 residences in the period from 1981 to 1984. Effects of tariff changing from H3 to H4.** Livik, K. Elektrisitetsforsyningens Forskningsinstitutt, Trondheim (Norway). Jun 1988. 46p. (In Norwegian). Order Number DE89914784/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report analyses the results from the measurements done on the electric load development for a number of 129 detached and semi-detached houses located in various parts of Norway. The measurements were executed from 1981 to 1984. The main target of the analysis was to evaluate the influences from the use of various types of tariffs. The load development depends to an essential degree on the methods of heating, types of tariffs and cost relations between petroleum and electricity. The most expensive increase in the maximum load was recorded for the consumers using various heating systems and tariffs in the measuring period. The development of electricity consumption, maximum load, utilization time, climate dependence, and variation of electricity consumption between day and night, are investigated. 18 figs., 10 tabs.

45345 (ETDE-mf–9910994, pp. 4-91) **Structural energy conservation measures for new buildings.** Feist, W. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Aug 1987. (In German). In *Residential development planning in new development areas with a view to energy conservation.* Order Number DE89910994/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

A comprehensive illustrated survey informing about the positive effects of energy conservation on pollution control (carbon dioxide and climatic effects, social and safety problems, economic structure and employment, consequences) is followed by details on factors influencing the energy consumption of heating systems, such as the thermal insulation of outer building components, surface: volume ratios, passive solar energy systems, ventilation (e.g. carbon dioxide, odors, water vapor, radon, carbon monoxide, heat exchangers), heating systems (controllability, heat losses/distribution), and users (user-dependent energy consumption). Rules are annexed for energy-saving building construciton (avoidance of complicated structures, windows, rows of buildings facing east-west, wind breakers, vegetation between building blocks). (HWJ).

45346 (ETDE-mf–9910994, pp. 93-125) **Energy-saving and environmentally compatible heating systems in newly erected residential areas.** Klien, J. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Aug 1987. (In German). In *Residential development planning in new development areas with a view to energy conservation.* Order Number DE89910994/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Details are given on energy conservation criteria town planning engineers should consider when planning supply systems (evaluation criteria, demand parameters, marginal conditions). The efficiency of supply systems is explained in terms of their ecological compatibility, pollutant emissions, reference values, and characteristic values, i.e., thermal output: primary energy ratios. Block diagrams facilitate access to the determination of heat transfer factors for a decentralized dual-purpose power plant, a condensating power plant, and a heat pump. Reference is made to the ecological compatibility of supply systems (cogeneration, oil-fired central heating systems), and the economic efficiency of local heat supply concepts (basic data of ecological building projects). (HWJ).

45347 (ETDE-mf–9910994, pp. 126-144) **Legal basis of energy-saving development plans in Hesse.** Raabe, R. (Ministerium des Innern des Landes Hessen, Wiesbaden (Germany, F.R.)). Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Aug 1987. (In German). In *Residential development planning in new development areas with a view to energy conservation.* Order Number DE89910994/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Since energy became a basic criterion for planning in 1973, regulations continuously have been tightened and are expected to be defined clearer still in the coming years. Details are given on regulations concerning regional energy conservation and referring to the requirements of municipal energy supplies (municipal development schemes, development plans) including heat demands (topography, wind loads, configuration of building complexes, local plans), heat gains (solar energy, windows), and structural designs. Reference is made to the licensing of buildings (Thermal Insulation Ordinance), the interaction between residential structures and heat supply systems, and prohibited substances (prohibition of heating systems causing air pollution). (HWJ).

45348 (ETDE-mf–9910994, pp. 145-169) **Decisions relevant to energy conservation on the different levels of municipal development planning.** Fuerboeck, M. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Aug 1987. (In German). In *Residential development planning in new development areas with a view to energy conservation.* Order Number DE89910994/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Dealing with the planning of new buildings according to the requirements of energy conservation, part one of the three-parted contribution (co-paper) deals with the causes of planning deficits detected in the past (various groups participating in decision-making processes), and discusses feasible solutions (conditions and vehicles for the development of integrated municipal energy concepts). Part two deals with data referring to planning and engineering competences on the different planning levels (table), as well as with programmatic rules for development and object planning. Details are given on zoning (procedure) and local plan decisions relevant to energy conservation. Part three points out guidelines for the development of energy concepts (preparatory planning, analytical phase, final concepts). (HWJ).

45349 (ETDE-mf–9910994, pp. 170-175) **Regional planning requirements of energy-saving development plans.** Krawinkel, H. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Aug 1987. (In German). In *Residential development planning in new development areas with a view to energy conservation.* Order Number DE89910994/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

Energy conservation and environmentally/socially compatible energy utilization are the core of the regional planning scheme of South Hesse. Passive solar heating systems and the careful selection of sites with suitable climates (consideration of micro-climates) are intended to be contributing to the preservation of fossil fuels which has priority over other aims. Central electric power systems (cogeneration) are preferred to other systems. Demonstration programs will facilitate the utilization of local renewable energy sources in areas where natural gas supplies are not available. Development plans are a vehicle for urging the realization of environmentally compatible municipal energy schemes in newly erected residential areas. (HWJ).

45350 (ETDE-mf–9911005, pp. 1-9) **Energy conservation and elimination of health hazards.** Ehm, H. (Bundesministerium fuer Raumordnung, Bauwesen und Staedtebau, Bonn (Germany, F.R.)). Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jun 1987. (In German). In *2nd meeting of the energy consulting working committee, November 17, 1986: Thermal insulation - advanced systems made to meet present and future requirements. Proceedings.* Order Number DE89911005/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Noise insulation and thermal insulation are among the basic care-of-health requirements applying to residential buildings. An illustrated survey dealing with thermal insulation in accordance with the requirements of energy conservation discusses existing problems and possible solutions (e.g. heat recovery-based ventilation systems), parameters excerting an influence on the energy consumption of buildings (e.g. wall thicknesses, window soffits and reveals, thermal bridges), and the minimization of the effects of thermal bridges (examples shown in diagrams). Reference is made to future measures and the importance of appropriately selected building structures (combination of measures). Details on noise pollution abatement and the elimination of health hazards refer to the minimum and extended noise insulation of residential buildings (airborne and footfall noise insulation). (HWJ).

45351 (ETDE-mf–9911005, pp. 11-56) **Low-energy houses in Sweden and Denmark.** Feist, W. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jun 1987. (In German). In *2nd meeting of the energy consulting working committee, November 17, 1986: Thermal insulation - advanced systems made to meet present and future requirements. Proceedings.* Order Number DE89911005/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Low-energy houses (newly erected buildings) in Sweden and Denmark are characterized by an average energy consumption of

10 to 12 l fuel oil/m2. Photographs and diagrams (building structures, structural details) facilitate access to low-energy buildings and the regulations they are subject to. Details are given on the historical development of insulating standards in Sweden (traditional wood construction), district and central heat supplies, the effects of thermal insulation (flow sheets showing the energy consumption of one-family houses), and insulating materials (preferably synthetic materials). Descriptions of different forms of low-energy buildings (diagrams showing radiator performance characteristics) are followed by details on the row house complex of a Swedish-German project (electric power and heat supplies provided for by a small-scale cogeneration plant). (HWJ).

45352 (ETDE-mf–9911005, pp. 57-80) **Thermal insulation retrofitted - physico-structural aspects.** Fingerling, K.H. Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jun 1987. (In German). In *2nd meeting of the energy consulting working committee, November 17, 1986: Thermal insulation - advanced systems made to meet present and future requirements. Proceedings.* Order Number DE89911005/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; NTIS (US Sales Only), PC A06/MF A01.

Thermal insulation neglecting the physical principles it is based on can be causing considerable damage to buildings. According to DIN 4108 experts are required to see to the avoidance of factors such as the penetration of moisture. Based on a comprehensive account of physico-structural principles (damage caused by dew water, insulating clay fillings for framework constructions) details are given on indoor climates, and the physics of buildings (surface temperatures of different wall and insulating materials). Reference is made to damage due to the penetration of moisture in the case of wooden framework constructions, as well as to the insufficient or inappropriate thermal insulation of buildings (photographs showing the hazards of thermal insulation), and water vapour-inhibiting paints. Examples facilitate access to insulated inner and outer walls (isothermal characteristics). (HWJ).

45353 (ETDE-mf–9911005, pp. 81-99) **Energy conservation through highly insulated outer walls.** Autenrieth, K.U. (Daemmsystem Heck GmbH, Fussgoenheim (Germany, F.R.)). Institut Wohnen und Umwelt G.m.b.H., Darmstadt (Germany, F.R.). Jun 1987. (In German). In *2nd meeting of the energy consulting working committee, November 17, 1986: Thermal insulation - advanced systems made to meet present and future requirements. Proceedings.* Order Number DE89911005/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Details on highly insulated outer walls which can either be of the light-weight type (one layer) or consist of light or heavy wall materials (two layers with insulating layer facing inside; three layers with insulating layers incorporated in the core; two shells with outer insulation) are based on a summary of physico-structural factors such as thermal bridges, phase displacements (heat transfer), diffusion and condensation of water vapor (vapor barriers), and the service life of insulating layers (safety through guaranties). Reference is made to a flame-proof sandwich wall consisting of mineral fiber boards and lime-cement first/final coatings (mechanical anchorage, thermal parameters). (HWJ).

45354 (ETDE-mf–9914941) **Development and testing of high-temperature heat pumps. Final report.** Engelhard, J. M.A.N. Technologie G.m.b.H., Muenchen (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1985. 97p. (In German). Contract BMFT 03E5354A. Order Number DE89914941/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The object of this project was the development of high-temperature heat pumps which can be applied to the temperature range above 100°C using industrial waste heat to produce process heat. The working fluid R 114 was tested with condensing temperatures up to 125°C and steam was tested with condensing temperatures up to 180°C. The screw compressor CR 90 with oil lubrication was used for the compression of R 114. The oil system was optimized according to the high temperatures and the dependence of volumetric efficiency and required power on inlet pressure, outlet pressure and peripheral velocity was measured. The oil-free screw compressor CP 80 was used for the compression of steam. A process was found, by which the final temperature can be controlled. By a graphic evaluation of the measured data a numerical equation was found to compute the volumetric efficiency and the required power of this compressor. (orig.) With 17 refs., 7 tabs., 50 figs.

45355 (ETDE-mf–9914943) **Low-temperature heating for the new building area Glockenberg in Wolfsburg. Final report.** Breuer, W.; Redecke, R. Forschungsgesellschaft Wolfsburg m.b.H. fuer Energie-, Wasser- und Verkehrstechnik (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). Oct 1986. 55p. (In German). Contract BMFT 03E-5385-A. Order Number DE89914943/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Utilization of the waste heat of industrial enterprises, of the backflow of district heating nets, and of the solar energy is a step towards energy conservation. This energy can only be used efficiently for low-temperature heating plants - partially combined with heat storages. The planning of the long-time heat storage 'Prototype Wolfsburg' started in 1980 and was finished in 1982. At the same time the planning and construction of the low-temperature service area began. 23 one-family houses have been equipped with low-temperature heatings and supplied with low-temperature district heating (60/30°C). Extensive measurements permitted a precise description of the behaviour of the low-temperature net dependent on the outside air temperature and the consumers way of acting. The studies attested the usability of low-temperature heatings in connection with low-temperature district heatings. Therefore it could be demonstrated that energy resources which largely have not been used until today, can efficiently be applied to supply the heating demand. (orig.) With 7 refs., 4 tabs., 34 figs.

45356 (GB–194) **Use of BREFAN to measure the airtightness of non-domestic buildings.** Perera, M.D.A.E.S.; Stephen, R.K.; Tull, R.G. Building Research Establishment, Watford (UK). Apr 1989. 3p. (BRE-IP–6/89). Order Number DE89916370/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

BREFAN is a fan 'pressurisation' rig designed to carry out air leakage tests on the whole building envelope of most non-domestic buildings, like offices and hangars. Field measurements with BREFAN in two office buildings are described and the way in which a 'leakage' index can be evaluated and then used as a diagnostic measure of the constructional quality of the external fabric of the building are shown. BRE provides a BREFAN measurement service to architects, builders, building services engineers, surveyors and others concerned with the provision and control of ventilation in buildings. (author).

45357 (GB–196) **Designer's manual for the energy efficient refurbishment of housing.** British Standards Institution, London (UK); Department of Energy, London (UK). [1989]. 46p. Order Number DE89914538/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A design manual has been written which recommends standards for energy efficiency based on a general consensus arising from numerous field trials of low energy housing. Details are given of how to optimize site conditions and solar gain, insulation of ceilings, walls, floors and windows, freedom from draughts and controllable ventilation, fuel choice, heating systems, lights and appliances and extensions. The manual gives typical details of how those standards can be achieved and how to make choices between different options. Potential problems and ways of overcoming them are also detailed. (U.K.).

45358 (HPC-R–3-1) **Comparison of national standards. Testing and rating procedures for heat pumps.** Edler, A.; Schaup, P. IEA Heat Pump Center, Eggenstein-Leopoldshafen (Germany, F.R.). Dec 1986. 163p. Available from IEA Heat Pump Center, Eggenstein-Leopoldshafen (Germany, F.R.).

A detailed survey is given (using tables, diagrams, systems diagrams, test formulae) of the fixed (national) regulations for the testing and rating of heat pumps in Austria, Japan, Sweden, Switzerland, the Netherlands, France, the Federal Republic of Germany and the USA. Details are given of the national and international standardization of heat pumps (terminology, definition) and

of the historical development of testing (test conditions, test procedures, type testing) and rating (safety requirements: hot water and pressure vessels, materials and construction) of the following types of heat pump: brine/water, air/water, brine/air, water/air. The CEN proposals for the unification of regulations and standards are listed and finally recommendations are made for the removal of constraints still in existence. (HWJ).

45359 (IBP-WB–8/1987) **A simple hybrid system for saving heat by means of a pebble storage unit and a glazed attic.** Erhorn, H.; Gertis, K.; Rath, J.; Wagner, J. Fraunhofer-Institut fuer Bauphysik, Stuttgart (Germany, F.R.). 1987. 14p. (In German). Available from Copy held by UB/TIB Hannover.

An experimental building was set up on an area reserved for studies of buildings. One half of the building is equipped with a hybrid solar system which consists of a roof inclined towards the South (10 m^2 glazed area), a pebble storage unit (3x1x0.5 m) and two ventilators. The other half of the building was built in the conventional way as serves as reference building. Measurements of temperature and solar radiation revealed that the while the roof did very well in terms of passive solar energy collecting, its contribution to the hybrid system was less important and that the pebble store in the cellar was (a) too large and (b) installed in the wrong place. During the summer, the summer heat increased the temperatures in the test room. Cooling the air by passing it through the pebble store could reduce the heat only slightly. Conclusion hybrid systems need to be designed very carefully. 2 figs., 2 tabs. (HWJ)

45360 (Juel-Spez–473) **Climatic zones and rural housing in India. Part 1 of the Indo-German project on passive space conditioning.** Scientific series of the International Bureau. Bansal, N.K.; Minke, G. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Internationales Buero; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. 284p. Contract BMFT 03E-8665-A. Order Number DE89914839/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Recordings of air temperature, air humidity, rainfall, wind speed and average number of clear days per month were available from 233 stations in India. The data was averaged over 36 years and analysed in detail for each station. On the basis of this analysis, the 233 locations were used to define six climatic zones. Measured data on solar radiation was limited to global radiation values and was available from only a few stations. Moreover, it was observed that for a clear day, the deviations in the solar radiation intensities at different stations were rather small. Representative locations were assigned to each climatic zone, based on the analysis of the available climatic data, and divided into three categories: Average where the mean temperature of the location is close to the average temperatures of all the locations within the zone. Lower Extreme where the average temperature of the location is close to the minimum average temperatures of all locations in that zone. Upper Extreme where the average temeprature of the location is close to the maximum average temperatures of all locations in that zone. The detailed values of the climatic parameters of each station were arranged in the form of standard graphs and tables, in order to facilitate comparisons between them. A survey of vernacular architecture was undertaken around the representative locations. The 21 examples were selected on the basis of typical climatic design features, and the plans, elevations, construction materials and details were recorded, as well as the topography, built environment, vegetation and other outdoor features. These details along with the respective climatic data are presented. The most significant passive design elements used in the construction of the houses were identified and are listed in each case. (orig./KW).

45361 (KTM/E-D–169) **Cooling in buildings, pilot study.** Punttila, A.; Wiksten, R.; Nuorkivi, A.; Takki, T. Kauppa- ja Teollisusministerio, Helsinki (Finland). Energiaosasto. 1989. 106p. (In Finnish). Order Number DE89787743/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The purpose of this pilot study was to review cooling in buildings as it exists today and prognose future development trends. A goal was also to present needs for possible research and development projects. Cooling in buildings can be divided into two generic types: passive cooling methods and active or mechanical cooling. In addition of typical methods some new and uncommon ways of cooling in Finland were also described. In this study available weather data was further processed and new cooling design data was developed for three cities (Helsinki, Jyvaeskylae and Sodankylae). Cooled building stock was estimated to be about 20 million m^3 today i.e. about 6% of the total volume of commercial, public and industrial buildings in Finland. Electricity consumption of the cooling is about 57 GWh and the peak load demand respectively about 130 MW. According to the fastest growing trend the total volume of cooled space would be in the year 2000 over four times larger than today, 92 million m^3. Electricity consumption would increase in the same time up to 268 GWh and peak load demand up to 494 MW. According to the lowest growing trend the figures would remain about the same as today. According to the fastest growing trend the annual turnover of building sector cooling market would grow from today's 400 million FIM in the year 2000. The increase of the turnover would create about 1100 new jobs in building cooling branch in addition to the existing 1300 jobs.

45362 (KTM/E-D–170) **Avoiding the disadvantages of overdimensioning of HVAC equipment in operation and restoration.** Ahtila, P.; Sainio, E.O.; Mattila, H. Kauppa- ja Teollisusministerio, Helsinki (Finland). Energiaosasto. 1989. 168p. (In Finnish). Order Number DE89787744/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The study discusses the most significant disadvantages of overdimensioning as measured by investment and running costs. In buildings under restoration overdimensioning causes extra investment costs. To improve the situation the ways have been developed to determine actual design values. The additional aim has been to find ways to minimize the disadvantages of overdimensioning in operating devices. The study consists of studys already made about the subject, interviews, measurements and calculations of effects of overdimensioning. The disadvantages of overdimensioning of different HVAC devices are introduced at first. After that it has been studied, how overdimensioning can be detected by observing the operation of devices and by doing measurements and calculation. These methods have been tested in practise in some buildings. The most common and harmful overdimensioned devices, namely heating equipment, radiators and control valves, have been measured most. Instructions for designers and contactors for avoiding overdimensioning in buildings which will be restored have been made on the basis of this study. Instructions to reduce disadvantages of overdimensioning in operating devices have been made for operational personnel.

45363 (LBL–24965) **Air cleaner efficiencies for removal of nitrogen dioxide and volatile organic compounds.** Daisey, J.M.; Hodgson, A.T. Lawrence Berkeley Lab., CA (USA). Apr 1988. 19p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-880679–13: 81. annual meeting of Air Pollution Control Association, 19-24 Jun 1988). Order Number DE89015384/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this research was to measure the initial effective cleaning rate (ECR) of selected air cleaners for removing NO_2 and six representative volatile organic compounds (VOC) from air. Four portable air cleaners, representing three different principles of particle removal and incorporating activated carbon, were investigated. Experiments were conducted in a closed Environmental Chamber using analyte concentrations similar to those reported in residences. Effects of relative humidity, temperature, filter particle loading and saturation of the adsorbents on the ECRs were not investigated in this preliminary study. However, the effect of extended usage was investigated for one air cleaner. Two of the air cleaners were found to be reasonably effective initially in removing NO_2 and five of the six VOC. These two devices had relatively high flow rates and the greatest amounts of activated carbon. None of the devices removed dichloromethane, the VOC with the highest vapor pressure. One air cleaner emitted 1,1,1-trichlorethane and formaldehyde. After being used in a residence for 150 hours, the ECRs for the air cleaner which had the highest initial values decreased substantially. This use was only about 15% of the predicted filter lifetime. Conversion of NO_2 to NO was also observed for this device but only after it had been used in the residence. 25 refs., 2 figs., 4 tabs.

45364 (LBL–27213) **Buildings of the 21st century: A perspective on health and comfort, and work productivity.** Daisey, J.M. Lawrence Berkeley Lab., CA (USA). May 1989. 22p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC03-76SF00098. (CONF-8905200–1: International Energy Agency's workshop on buildings of the 21st century, 16-18 May 1989). Order Number DE89015341/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The purpose of this paper is to examine our understanding of the relationships between the dependent variables of health, comfort and productivity and the environmental and other factors (independent variables) which influence these in the context buildings and building practices. Trends that are likely to have impacts on buildings of the 21st Century are discussed. 38 refs., 4 figs., 2 tabs.

45365 (LBL–27362) **Spatial and temporal variation in factors governing the radon source potential of soil.** Sextro, R.G.; Nazaroff, W.W.; Turk, B.H. Lawrence Berkeley Lab., CA (USA). Oct 1988. 16p. Sponsored by DOE/CE;EPA. DOE Contract AC03-76SF00098. (CONF-8810134–7: Symposium on radon and radon reduction technology, 17-21 Oct 1988). Order Number DE89016313/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Soil is the predominant source of radon in most US homes, particularly for those homes with elevated indoor concentrations. Three factors help govern the indoor radon concentration, the radon production rate in the soil, the air permeability of the soil surrounding the building substructure, and the coupling between the soil and the building. In order to evaluate the spatial and temporal variability of the first two factors, soil permeabilities and soil gas radon concentrations have been measured at different locations and as a function of time. The spatial variability in permeability measurements at an individual homesite was seen to range from approximately a factor of ten to more than four orders of magnitude. Similarly, spatial variations in soil gas radon concentrations are less than a factor of two at some homesites to a factor of ~200 at others. The temporal changes in permeability and soil gas radon at a given sampling location are somewhat smaller, yielding variations ranging from less than a factor of two to a factor of ~90 in the case of permeability, and from less than a factor of three to a factor of ~40 for soil gas radon concentrations. A method of combining measurements of soil gas radon and air permeability to provide a characteristic parameter – the radon source potential – has been developed and is briefly reviewed. Calculated indoor radon concentrations, based on measured values of radon source potential at a few sample homesites, correlate with the measured indoor radon concentrations. 8 refs., 4 figs., 3 tabs.

45366 (NBSIR–88-3739) **Comparison of direct digital control and pneumatic control systems in a large office building.** Bushby, S.T.; Kelly, G.E. National Bureau of Standards, Washington, DC (USA). Building Environment Div. Mar 1988. 52p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-86CE21012. Available from OSTI.

A distributed, microprocessor-based direct digital control (DDC) energy management and control system was developed and installed in an eleven story office building in Gaithersburg, Maryland. Over a period of one year the performance of this system under various control strategies was investigated along with the performance of a conventional pneumatic control system. The quality of control and performance characteristics for the two control systems were compared. Overall the DDC system was found to maintain better control of the supply air temperature and to follow planned reset schedules more closely than the pneumatic system. One particular air handling unit performed as well under pneumatic control as it did under DDC in maintaining a supply air setpoint, but it did not precisely follow the planned reset schedule. Each air handling unit had different performance characteristics while under pneumatic control, but all units behaved essentially the same under DDC. The results indicate that a pneumatic system can perform as well as a DDC system but more effort is required to maintain system performance. The DDC system was found to be flexible and it is easier to insure that multiple air handling units follow the same control strategy with the DDC system. The instrumentation associated with the DDC system proved to be very useful in troubleshooting problems with the pneumatic system because of the information readily available to the operators. 9 refs., 27 figs.

45367 (NRC–1989) **Indoor ice arenas. Humidity caused problems and suggested solutions.** National Research Council of Canada, Ottawa, ON (Canada). [1989]. 42p. (MICROLOG–87-05010). Available from Ontario Ministry of Tourism and Recreation, Communications Branch, Customer Sales & Service Section, 77 Bloor St., W., Toronto, ON, CAN M7A 2R9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report was prepared to assist indoor ice arena managers in Canada to solve common problems related to humidity. These problems typically include leaking roofs, deterioration of roof and insulation, condensation on indoor walls, damages to exterior walls due to condensation on exterior metal parts, rusting metal elements, high energy bills, and long and costly ice-making periods. Recommendations are made for improved roof insulation systems, proper sealing, maintenance, and repair. High energy costs are seen as due to insufficient insulation, air leakage, and heat losses by radiation and convection. Convection can be controlled by dehumidification and shielding the ice from air currents. Radiation losses can be lowered by using a low-emmissivity suspended ceiling; this effectively breaks the flow of radiated heat from the roof toward the ice sheet, and has the additional benefit of lowering of lighting energy demand by acting as a reflector. It is shown that these measures can result in significant energy cost savings with favorable payback periods. 10 figs.

45368 (NRC–1989) **Indoor swimming pools. Humidity caused problems and suggested solutions.** National Research Council of Canada, Ottawa, ON (Canada). [1989]. 39p. (MICROLOG–87-05001). Available from Ontario Ministry of Tourism and Recreation, Communications Branch, Customer Sales & Service Section, 77 Bloor St., W., Toronto, ON, CAN M7A 2R9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Reports have been received from across Canada on premature deterioration and other problems of indoor swimming pool buildings. This technical paper has been prepared to assist pool managers to solve these problems, which typically include leaking roofs, condensation on inside walls, peeling paint, efflorescence, rusting of metal elements, deterioration of concrete block structures, and high costs for pool heating. An effective insulation and vapor barrier system for a swimming pool roof is described, and the high relative humidity of the typical pool building is discussed as the primary cause of most problems. Proper sealing to cut down air infiltration is recommended, along with proper maintenance and painting. High energy costs are often due to low insulation values and to excessive ventilation used for decreasing the humidity. By using dehumidifiers capable of heat recovery, and by placing an insulating blanket on the pool after operating hours, it is shown that substantial cost savings are possible. 10 figs.

45369 (OH/RD–78-97) **The potential for energy conservation in major electrical appliances.** Bell, J.M.; Jones, W.R. Ontario Hydro Research Div., Toronto, ON (Canada). 1982. vp. (CE–02735). Available from Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Research on the six major domestic electrical appliances has shown that reductions in energy consumption of up to 50% can be achieved. Techniques were developed to measure realistic energy consumptions and were incorporated into six new standards formulated at the Canadian Standards Association with the cooperation of the appliance manufacturers. Based on these standards, energy consumption labels are now required by the federal government of these appliances. In addition, studies of use habits have resulted in a number of consumer tips that can be used in customer information packages. 11 refs., 4 figs., 2 tabs.

45370 (OH/RD–87-177-K) **Northern climate heat pump laboratory evaluation.** Yap, S. Ontario Hydro Research Div., Toronto,

ON (Canada). [1989]. V (MICROLOG–89-02656). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

One of the seven prototype Canadian Electrical Association northern climate heat pumps was installed and tested in Ontario Hydro's heat pump laboratory. The tests show that the steady-state coefficient of performance figures are 15 to 20% higher than those of a commercially available model tested in 1985. Low-temperature heating performance surpassed that of all current air-source heat pumps on the market. 5 refs., 8 figs., 2 tabs.

45371 (OH/RD–88-42-K) **On calculating house energy consumption simply.** Jones, W.R. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 8p. (MICROLOG–89-02711). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The basic thermal characterization of a house envelope is the same for heat loss and energy consumption calculations (the sum of component area/resistance times relevant temperature difference). To size the heating system for heat loss, a design (i.e., extreme cold) temperature difference is used together with the assumption that no other sources of heat are operative. For energy, a heating season integration incorporating internal and solar gains is needed. The traditional degree-day method is meant to capture the simplicity of the heat loss calculation for an energy determination. This report discusses the empirical correction factor required by this method, and the resulting accuracy of the method. Based on actual house data, the correction factor in the formulation (the C-factor) is shown to be house-specific, with an average value of 19. 8 refs., 1 fig., 3 tabs.

45372 (OH/RD–88-57-K) **Energy savings factors and conversions for pocket reference booklet.** Chiarelli, M.; Howell, B.T.; Jones, W.R. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 14p. (MICROLOG–89-02710). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Before publishing a replacement for the pocket reference booklet "REAP Conversion and Energy Savings Factors", a guide used for quick reference by Ontario Hydro's Customer Service staff, verification or revision of the heating fuel conversion factors, heating fuel efficiencies, and energy savings factors were requested. This report gives the confirmation, expansion, and new developments for the booklet in fuel energy conversions, heating system efficiencies, and retrofit energy savings factors. 1 fig., 7 tabs.

45373 (ORNL/CON–286) **Technology adoption strategy for the Existing Buildings Efficiency Research Program.** Mihlmester, P.E.; Gonos, J.; Freeman, L.; Brown, M.A. Oak Ridge National Lab., TN (USA). Jun 1989. 110p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015689/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This study was conducted for the Oak Ridge National Laboratory (ORNL) Existing Buildings Efficiency Research Program (EBER) which is implemented for the US Department of Energy's Office of Buildings and Community Systems. The purpose of the study is to characterize the building energy retrofit service industry, describe the technology adoption process within this industry, identify paths through which retrofit technologies can be adopted, and develop a technology adoption strategy to support the EBER Program. This study builds on past research in the technology transfer area and attempts to tailor a technology transfer strategy for the EBER Program while focusing on the retrofit services industry. The retrofit services industry can be defined as the businesses that constitute the path from building retrofit inception to the completion of the project. To accomplish the goals of this study, a three-phased methodology was used. The three phases consisted of (1) background analysis and segmentation of the retrofit industry structure; (2) interviews of building retrofit service industry association members; and (3) conducting an actual building energy retrofit service industry practitioners' workshop for direct information input. 6 refs., 16 figs.

45374 (ORNL/FTR–3330) **[Problem areas of a general nature in the use of nonazeotropic refrigerant mixtures in heat pumps and refrigerating systems, Oak Ridge, TN, December 30, 1988–June 29, 1989]: Foreign trip report.** Granryd, E.G. Oak Ridge National Lab., TN (USA). 5 Jul 1989. 6p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015953/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The work has primarily been focused on a few different problem areas of a general nature in relation to the use of nonazeotropic refrigerant mixtures (NARMs) in heat pumps and refrigerating systems.

45375 (ORNL/M–863) **Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report.** Coleman, G.L.; Samples, S.D. (comps.). Oak Ridge National Lab., TN (USA). May 1989. 53p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015654/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Monthly Report of the Building Thermal Envelope Systems and Materials (BTESM) Program is a monthly update of both in-house ORNL projects and subcontract activities in the research areas of building materials, wall systems, foundations, roofs, building diagnostics, and research utilization and technology transfer. Presentations are not stand-alone paragraphs every month. Their principal values are the short-time lapse between accomplishment and reporting and their evolution over a period of several months.

45376 (ORNL/M–907) **Building Thermal Envelope Systems and Materials (BTESM) and research utilization/technology transfer progress report for DOE Office of Buildings and Community Systems: Monthly progress report.** Coleman, G.; Samples, S.D. (comps.). Oak Ridge National Lab., TN (USA). Jul 1989. 39p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015657/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Monthly Report of the Building Thermal Envelope Systems and Materials (BTESM) Program is a monthly update of both in-house ORNL projects and subcontract activities in the research areas of building materials, wall systems, foundations, roofs, building diagnostics, and research utilization and technology transfer. Presentations are not stand-alone paragraphs every month. Their principal values are the short-time lapse between accomplishment and reporting and their evolution over a period of several months.

45377 (ORNL/Sub–86-SA578/1) **Free-Piston Stirling Engine magnetically coupled heat pump: Critical component evaluation: Phase 1, Final report.** Chen, G. Oak Ridge National Lab., TN (USA); Sunpower, Inc., Athens, OH (USA). Aug 1989. 46p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015646/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The Free-Piston Stirling Engine (FPSE) Magnetically Coupled Heat Pump Program at Sunpower involves the development of a FPSE/magnetic coupling/compressor (FPSE/MC/C) assembly for a gas residential heat pump application. The objectives of Phase 1 were (1) to evaluate the feasibility and characteristics of critical components such as a linear magnetic coupling and hermetic sealing, (2) to demonstrate through tests the performance of a magnetic coupling/compressor assembly, and (3) to evaluate the system concept design by applying an air-charged FPSE. 9 refs., 20 figs., 5 tabs.

45378 (ORNL/TM–11125) **A Z8 FORTH assembler for SMART HOUSE prototyping.** Gryder, R. Oak Ridge National Lab., TN (USA). Aug 1989. 39p. Sponsored by National Association of Home Builders Research Foundation. DOE Contract AC05-84OR21400. Order Number DE89015675/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report presents an extension of the Zilog Z8/FORTH microcontroller system software by defining FORTH words to implement a Z8 assembler. The work was conducted for the National Association of Home Builders' Smart House Project, a cooperative research and development effort involving American home builders and several major corporations that provide products and services to the home building industry. The major goal of the development of new residential products for communications, energy distribution, and appliance control. Use of a high-performance, easily-adaptable microcontroller such as the Zilog Z8 can facilitate the testing Smart House product prototypes. The device can be used to meet numerous sensing, tracking, and test-suite generation needs, and can provide an important function in system testing by simulating the operation function in system testing by simulating the operation of associated Smart House components. The intent of this report is to provide the Smart House Project team with information concerning the programming techniques needed for developing and testing Smart House products. The material is technical in nature and assumes considerable experience in microcontroller technology and microcomputer programming. 5 refs., 1 fig., 8 tabs.

45379 (PNL–6735) **Environmental assessment in support of proposed voluntary energy conservation standard for new residential buildings.** Hadley, D.L.; Parker, G.B.; Callaway, J.W.; Marsh, S.J.; Roop, J.M.; Taylor, Z.T. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 204p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89015209/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

The objective of this environmental assessment (EA) is to identify the potential environmental impacts that could result from the proposed voluntary residential standard (VOLRES) on private sector construction of new residential buildings. 49 refs., 15 tabs.

45380 (PNL-SA–16451) **Energy conservation standards: Promoting energy efficient new non-residential buildings in the United States.** Crawley, D.B. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-890828–1: 2. world congress on heating, ventilating, refrigerating and air conditioning, 27 Aug - 1 sep 1989). Order Number DE89016566/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the past fifteen years, a number of energy conservation standards for the design of new non-residential buildings have been promulgated in the United States. These vary in their approach from component level prescription of minimum efficiencies or levels of insulation to whole-building energy goals. Over the past five years, the US Department of Energy (USDOE), the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), and the Illuminating Engineering Society (IES) of North America have been cooperatively developing the next generation of energy conservation standards for the United States. This paper describes those efforts and provides a comparison of the anticipated benefits (energy savings) resulting from recently adopted standards (the US Department of Energy Non-Residential Standards, and ANSI/ASHRAE/IES Standard 90. 1P). A series of annual energy simulations of various types of non-residential buildings was performed to assess the impacts of the requirements of the standards. The results of these simulations (using the DOE-2.1C hourly energy simulation program) are presented and discussed. 4 refs., 2 figs.

45381 (SI-R–851203-1) **PAH (Polycyclic Aromatic Hydrocarbons), dust and mutagenicity in flue gases from wood firing in a tile stove.** Benestad, C. Senter for Industriforskning, Oslo (Norway). Dec 1988. 15p. (In Norwegian). Order Number DE89914767/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The report analyses the results from the sampling of PAH (Polycyclic Aromatic Hydrocarbons), dust, and mutagenicity in the flue gases discharged from the combustion of wood in a tile stove. The presented results from the measurement show that the discharged volumes of pollutants from the stove are comparable to those of smaller wood-fired furnaces or simple-designed central heating boilers fired with wood. 3 figures, 8 tables.

45382 (STEV-LS–89-1) **Environmental effects of a lake water source heat pump with heat storage in the sediments of the Vallentuna lake.** Ahlgren, I.; Friman, M. Statens Energiverk, Stockholm (Sweden). 25 May 1989. 67p. (In Swedish). Order Number DE89914795/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The influence of the heat pump on the turnover of nutrition salts, planktons and bottom fauna is investigated as the lake was already strongly eutrophicated. Increasing water flow causes the emergence of oxygen consuming species such as midge larvae and flat worms. The turnover of nutrition salts and production of algae is not affected. (G.B.).

45383 (TYOT-JULK–302) **Sunspaces for housing in Finland.** Woolston, G.; Alanko, A.; Nurmisto, U.; Janhonen, H. Tyotehoseuran Julkaisuja, Helsinki (Finland). 1989. 100p. (In Finnish). Order Number DE89787747/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The Finnish climate permits at best a ten week growing season and very limited outdoor activity at comfortable temperature. Thus the more favourable growing conditions and semi-outdoor living space offered by sunspaces are particularly valuable. Verandas are traditional but greenhouses have been used mainly in horticultural applications. Interest is growing in all types of small glazed spaces for use in housing - also the newer types. This brought about a need to study user experience. Results from 20 sunspaces built recently were collected, and additional information and viewpoints were solicited from architects, planning officials and building inspectors. A survey was made of manufacturers' greenhouse and veranda packages, as well as of available equipment. The sunspaces studied were built as extensions to living space, as greenhouses (heated and unheated), and as solar collectors to assist in heating the dwelling to which they were attached. Often purposes were combined. None were built solely o save energy, and all groups interviewed had little information on this possible use of the sunspace, which has not been sufficiently well researched in Finland. The research showed that there is a lack of recommendations relating to the requirements of sunspaces in use, in design, in the building regulations, and in town and country planning. A start was made in this direction with some directions, design guidelines and details at the end of this report. There is also a need for more thorough investigation through experimental building - as carried out in many European countries with far more favourable natural climates.

45384 (TYOT-JULK–304) **Influence of dishwasher type on energy consumption in institutional kitchens' dishwashing.** Rytkoenen, A. Tyotehoseuran Julkaisuja, Helsinki (Finland). 1989. 121p. (In Finnish). Order Number DE89787748/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The purpose of the study was to determine the circumstances in which a tunnel type dishwasher consumes less energy than a hood type dishwasher when used in institutional kitchens of certain type and size. The study consists of two phases: field and labortory trials. Ten kitchens were involved in the field trials. The laboratory trials were designed on the basis of the results obtained in the field trials. The profitability calculations are based on the results obtained from the laboratory trials. According to the field and laboratory trials, the major cost factor occurring with dishwashers is that of labour costs. They represented approx. 80% of the combine operating and labour costs. Of the operating costs, that of power consumption was lower for hood type machines. Water consumption was lower for tunnel type machines. The two machine types did not differ a great deal in terms of detergent and rinsing fluid consumption.

45385 (TYOT-JULK–305) **On timing the use of household appliances.** Sotku, R. Tyotehoseuran Julkaisuja, Helsinki (Finland). 1989. 111p. (In Finnish). Order Number DE89787746/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

The purpose of the study was to clarify the situation regarding possibilities for timing the use of household appliances from the point of view of both the user and appliance technology. The study dealt with the use of household appliances in households with a twin tariff for electricity. The technological possibilities were looked at in the light of the present range of appliances as well as taking into consideration the possibilities offered by product development.

Experts' opinions concerning timing in the use of household appliances was also included. The use of household appliances during the lower electricity tariff was clarified by sending a questionnaire to over 800 households located in regions served by four electricity companies. The areas had different electricity tariffs. Acceptable responses were received from 492 households which corresponds to a responce of 58%. In the majority of the households who responded to the questionnaire one or more appliances had been used during the lower tariff. Commonly, this consisted of heating the house and providing hot water, washing clothers and dishes. When looking at the technological possibilities for timing the use of household appliances, the safety aspect of using household appliances becomes emphasised. Various systems have been developed to improve the water safety of washing machines. Generally speaking, dishwashers are more advanced in this respect than washing machines. There are, however, washing machines which still lack a safety system. When experts were consulted for their opinions, timing the use of appliances was seen to be partly possible but there were some reservations about it, too. Adequate safety in using the appliance was considered to be a matter of primary importance. Timing technolcgy must be taken into account already at the product design stage.

45386 (UNIES–M91-11-2-5-1989E) **Flair Homes Project report no.5. Airtightness performance of twenty detached houses over a two-year period.** Proskiw, G.; Beckman, J. UNIES Ltd., Winnipeg, MB (Canada). 1989. 62p. (CE–02754). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Airtightness tests were performed on 20 new houses over a 2-year period in Winnipeg. The houses were constructed with a variety of air/vapor barrier systems and 3 different types of main walls. Polyethylene was used as the air/vapor barrier in 6 of the houses while the remaining 14 used the airtight drywall approach (ADA). The houses had similar floor plans and were constructed by the same builder. Both the polyethylene and ADA systems were found to be capable of meeting the airtightness requirements of the R-2000 standard with the tightest structures being double wall houses. No significant or permanent change in airtightness was observed for any of the houses over the monitoring period. Application of stucco as an exterior finish was found to improve airtightness of the ADA houses, but not of the double wall houses with polyethylene vapor barriers. Consistent sources of air leakage in the ADA houses were found to be the electrical outlets on exterior walls. Window leakage was also noted in many houses and the frequency of this leakage increased over the monitoring period. A significant leakage source was found to be an integrated mechanical system, which ducted in large volumes of outdoor air. It was also concluded there is a need to re-examine the design pressure requirements for residential air barrier systems. Specifically, this should investigate how transient wind-induced pressure loads are resisted by air barrier systems and whether some portion of the load is taken by other envelope components. An air leakage detection system was proposed consisting of a simple non-instrumented blower, which would be suitable for use by builders to aid in the construction of low leakage houses. 17 refs., 10 figs., 8 tabs.

45387 (VTT-TIED–937) **Modern oilheating.** Korhonen, R. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1989. 53p. (In Finnish). Order Number DE89787757/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Energy consumptions and efficiencies were measured in ten oil-fired domestic houses in Southern Finland during the period 1.9.1987-31.8.1988. The oilboilers were of the latest model and called module boilers. Six of the houses had been built after 1985 and four before 1973, respectively. Yearly oil consumption in the new houses was approximately 2 070 l/a and in the older ones 3 480 l/a. The average energy consumption for heating up the room space was 13 400 kWh/a for new houses and 28 200 kWh/a for the older ones. Making domestic hot water consumed energy on an average 3 300 kWh/family a and electricity was used about 6 500 kWh/family/a. An average annual efficiency of oilboilers was measured to be 82%. In three houses there was also a floor heating system in bathrooms and other sanitay spaces. In these cases 39, 80 and 89% of the total space heating energy, respectively, was delivered by heating up the floor in sanitary spaces. One could assume that this would result in unsteady room temperatures but this phenomena was found neither in discussions with the inhabitants nor in measurements. The total water consumption average 228 m^3/family/a. Domestic hot water was consumption 71 m^3/family/a and cold water 156 m^3/family/a, respectively. During the research period service was done in six boilers. In one case the question was about annual contract service. In three houses the boiler was cleaned up by the owner himself and in four cases nothing was done during the year.

45388 (VTT-TIED–940) **Profitability of energy saving measures in residential buildings. Results of empirical study.** Haalahti, P.; Haakana, M.; Rejstroem, L.-O. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1989. 63p. (In Finnish). Order Number DE89787754/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

In this report the results of the research considering costs, energy savings and profilibilities of some energy saving measures are presented. Repairs investigated were as follows: replacement of oilburner, installation of thermostatic radiator valves, additional roof insulation and replacement of windows. Repairs were mostly done during the years 1985 and 1986. The aim of the research was to find out, how the conditions of repairs, technical bases and repair methods affect energy savings and profitability. The study was made as a field research involving both detached houses and apartment houses. Research materials consisted of 64 houses; 37 could be used in calculations. Energy savings alternated between 37-15% the average the only profitable measure turned out to be changing of oilburner. However, variations between different cases were great and also in some cases additional roof insulation as well as installation of thermostatic radiator valves proved to be profitable. Replacement of windows was unprofitable in all cases when considering energy savings only. Energy saving was the main reason for repairs in every fourth case, only. In most cases repairs were done for improving thermal comfort, which is a decisive factor considering total effects of the repairments as a whole. A comparison material (repairments done during the years 1978-1980) was treated together with the actual research material. According to the figures of the comparison material energy savings were on the average 12,1%, which is much more than in the actual research material. The difference in figures can be explained by larger saving potentials of houses in the late 1970s and also by common interest towards energy saving in those days.

45389 (VTT-TUTK–585) **Calculation of room air flows with CHAMPION SGE-program.** Piira, K.; Heikkinen, J.; Korhonen, R. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). 1989. 134p. (In Finnish). Order Number DE89787756/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The aim of this work was to investigate applicability of the two-dimensional CHAMPION SGE-program in claculation of indoor air flows. The program was improved by a graphics program and by program module for an unstationary calculation of contaminant field. Further, the turbulence model used in CHAMPION SGE was modified for small Reynolds numbers. The applicability of CHAMPION SGE was tested by simulating indoor air flows with CHAMPION SGE-program in IBM AT/E-environment. The simulation results were compared with measured in industrial collaboration and with results given in the literature. It was also examined how different descriptions of three-dimensional room space affect the results. The program for calculating contaminant field was realized by utilizing the air speed and the effective viscosity determined by CHAMPION SGE. Graphics program was made by using parts of the GROCS-program, which is included in the original CHAMPION SGE package. Turbulence model was modified by making constants C_μ and C_2 of the k-ϵ -model into functions of turbulent Reynolds number and modifying the dissipation boundary conditions based on the balance of diffusion and dissipation of turbulent kinetic energy in the viscous bottom layer. CHAMPION SGE gives fairly good results in two-dimensional air flows in unoccupied room if the boundary conditions are given correctly. Problems are flow obstacles, two-dimensional modelling of an air terminal device, heat transfer

coefficients in free convection and numerical errors in those parts of the grid, where the aspect ratio of cells is small. The contaminant field results are good according to preliminary studies, if the result in the flow field calculation is realistic. Modifications of the turbulence model did not essentially affect the flow field.

45390 **Protocols to guide building energy monitoring projects.** Mixon, W.R. (Oak Ridge National Lab., TN (USA)). *ASHRAE (American Society of Heating, Refrigeration and Air-Conditioning Engineers) Journal (USA),* 31(6): 38-43 (Jun 1989).

ASHRAE TC 9.6 Subcommittee on Building Monitoring has been active since January 1986. Its goal is to improve the quality and effectiveness of building energy monitoring activities. The development of consistent energy monitoring protocols is seen to be of fundamental importance. Protocols are considered to be experimental plans, specifications or procedures for various field monitoring activities, which generally are useful to others as models or examples. Of primary concern to ASHRAE are the methods and procedures for monitoring as opposed to the selection and use of hardware. The projects of interest generally include field measurement of the energy use of buildings and/or building systems, and factors that affect energy use. It has been proposed that monitoring practitioners adopt the suggested protocol framework and further develop its details through use and professional society activities. The effort to develop a more uniform structure for monitoring protocols based on what is accepted as good practice should promote more efficient use of scarce monitoring resources and programs. Protocols would reduce the effort required for project planning and experimental design, help assure that sufficient information is collected to accurately meet project objectives and enhance the feasibility of data exchange between similar monitoring projects. The development and use of protocols also can give monitoring project sponsors the assurance that all aspects of the project meet accepted practice guidelines.

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Refer also to citation(s) 45500

45391 (CCA–83) **Transportation energy conservation.** Arnold, S.J.; Turner, R.E. Consumer and Corporate Affairs Canada, Ottawa, ON (Canada). 1983. vp. (CE–02676). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

This report concerns methods of transportation energy conservation and the development of a detailed proposal for a demonstration project. The report begins with the results of a literature survey of transportation energy conservation actions, including specific steps that individual travellers, private sector companies, or public sector organizations could undertake to conserve energy in the movement of travellers and materials. As the result of this search, over 200 separate actions were identified, grouped according to subject. The next chapter identifies target segments for the application of conservation actions, followed by the choosing of appropriate methods for implementing these actions, by identifying and explaining the principal types of change processes and reviewing the relevant literature for examples of their implementation. The final chapter identifies one from a list of seven candidate strategies and develops a detailed proposal for a demonstration project. This proposal involves the collection of data on the aggregate consumption of fuel for automobiles and other road vehicles as sold by commercial service stations within eight medium-sized cities in Canada. 212 refs.

45392 (CONF-8906150–3) **TRAF-EDIT: An interactive data editor for the TRAF simulation system.** Rathi, A.K.; Santiago, A.J.; Valentine, D.E. Oak Ridge National Lab., TN (USA). Jul 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 3. international conference on microcomputers in transportation; 21-23 Jun 1989. Order Number DE89017260/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes TRAF-EDIT, an interactive data entry/editing program for the TRAF simulation system. TRAF-EDIT will provide the user with the capability of creating an input data file or modifying an existing data file used as input to the TRAF simulation program. The paper describes the features and design philosophy of the program and four possible approaches for development under consideration. The current status of the program and its anticipated availability are also discussed. 6 refs., 1 fig.

45393 (MU/CRT–495) **STAN: an interactive-graphic system for strategic transportation analysis at the national and regional levels.** Florian, M.; Crainie, T.G.; Guelat, J.; Babin, A. Montreal Univ., PQ (Canada). Centre de Recherche sur les Transports. 1987. 27p. (MICROLOG–87-02963). Available from Centre de recherche sur les transports, Universite de Montreal, CP 6128, Succursale A, Montreal, PQ, CAN H3C 3J7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

STAN is an interactive graphic multi-product multi-mode method for national or regional strategic planning of freight transportation. At the strategic level of planning, the aim is to obtain an overall estimation of the movements of freight of most (or all) products by most (or all) of the modes available. A typical use of STAN is the comparison and evaluation of alternatives. Flows, link costs and delays, intermodal shipments and other performance indicators may be compared to those of the base scenario in order to carry out cost/benefit analyses. STAN allows the planner to engage in the planning process by using terminology that he is familiar with and obviates data processing type tasks. It also permits the instantaneous visualization of input data, results of computations and information retrieved from the data base, all in graphic or list form. This report describes the main features of this system, including the general concepts underlying the system, the data base structure, the assignment procedures and the results. Some examples of dialogs and outputs are also given. 9 refs., 13 figs.

45394 (ORNL–6549) **Light-duty vehicle mpg and market shares report, model year 1988.** Hu, P.S.; Williams, L.S.; Beal, D.J. Oak Ridge National Lab., TN (USA). Apr 1989. 263p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015670/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

This issue of Light-Duty Vehicle MPG and Market Shares Report: Model Year 1988 reports the estimated sales-weighted fuel economies, sales, market shares, and other vehicle characteristics of automobiles and light trucks. The estimates are made on a make and model basis, from model year 1976 to model year 1988. Vehicle sales data are used as weighting factors in the sales-weighted estimation procedure. Thus, the estimates represent averages of the overall new vehicle fleet, reflecting the composition of the fleet. Highlights are provided on the trends in the vehicle characteristics from one model year to the next. Analyses are also made on the fuel economy changes to determine the factors which caused the changes. The sales-weighted fuel economy for the new car fleet in model year 1988 showed an improvement of 0.1 mpg from model year 1987, while light trucks showed a 0.2 mpg loss. The 0.2 mpg loss by the light trucks can be attributed to the fact that every light truck size class experienced either losses or no change in their fuel economies from the previous model year, except for the large van size class. Overall, the sales-weighted fuel economy of the entire light-duty vehicle fleet (automobiles and light trucks combined) has remained relatively stable since model year 1986. Domestic light-duty vehicles began to gain popularity over their import counterparts; and light trucks increased their market shares relative to automobiles. Domestic cars regained 0.3% of the automobile market, reversing the previous trend. Similar to the automobile market, domestic light trucks continued to gain popularity over their import counterparts, partly due to the increasing popularity of domestic small vans. 3 refs., 35 figs., 48 tabs.

45395 (ORNL/M–916) **Light-duty vehicle summary, model year 1976 to the first half of model year 1989.** Williams, L.S.; Hu, P.S. Oak Ridge National Lab., TN (USA). Aug 1989. 42p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015667/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This summary covers more than thirteen years of light-duty vehicle data (i.e., automobiles and light trucks combined) from model

year 1976 through the first six months of model year 1989, on a nameplate level (e.g., Chevrolet Corsica is a nameplate). Included in this summary are estimated sales-weighted fuel economies, sales, and market shares of new automobiles and new light trucks sold in each model year. Comparisons and observations are made on the trends from one model year to the next.

45396 (OTC–1988) **Trucksave economy challenge, 1988. Vehicle and performance data results.** Ontario Ministry of Transportation and Communications, Ottawa, ON (Canada). 1988. 80p. (MICROLOG–89-04011). Available from Ministry of Transportation. Transportation Technology and Energy Branch, 1201 Wilson Ave., Downsview, ON, CAN M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report provides the results of competitions held to determine the best fuel economy performance by trucks and their drivers. Competitors, driving tractor-trailers of various types (e.g. van, flatbed, tanker) classed by weight, traveled specified routes in Ontario, and, in a separate contest, an interprovincial route. Participants were ranked on the basis of liters of fuel consumed per metric tonne of gross vehicle weight per 100 km. A time limit was enforced to prevent dangerously slow driving, and anyone not maintaining a specified speed was penalized. Results are presented for the various vehicle and weight classes; data also presented include vehicle characteristics and miles per gallon (adjusted and unadjusted).

45397 (PNL-SA–16415) **Design of ceramic fabric heat pipe with water working fluid.** Antoniak, Z.I.; Bates, J.M.; Webb, B.J. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890819–20: ASME/AIChE national heat transfer conference, 6-9 Aug 1989). Order Number DE89016565/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A novel class of space radiators, constructed of ceramic fabric materials selected for their high-temperature strength and optical characteristics, is under development at Pacific Northwest Laboratory (PNL). An earlier study indicated that heat pipe radiators constructed of fabric tubes lined with metal foil will have superior performance characteristics with lower mass than most other radiator types. Test results confirm these earlier predictions. 17 refs., 3 figs.

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Refer also to citation(s) 44444, 44861, 44868, 44992, 44993, 45001, 45002, 45003, 45170, 45219, 45302, 45308, 45311, 45355, 45428, 45461, 45462, 45463, 45464, 45465, 45466, 45875, 46106, 46180

45398 (AC/ESRI–1-944) **Summary of 1983-1985 contract reports of the Energy Research and Development in Agriculture and Food (ERDAF) Program.** Agriculture Canada, Ottawa, ON (Canada). Engineering and Statistical Research Inst. 1987. 132p. (In English and French). (MICROLOG–89-03052). Available from Agriculture Canada, Communications Branch, Sir John Carling Bldg., Carling Ave., Ottawa, ON, CAN K1A 0C5; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Supplementary to on-going in-house research, the Research Branch of Agriculture Canada contracted out research to non-federal government agencies or individuals. The contract reports summarized here result from the Energy Research and Development in Agriculture and Food Program. A brief summary is given for each project completed during the fiscal yeears 1980-83, a total of 62 contracts costing $4.19 million and including 13 primary industry, 25 consulting firms, 19 universities and 5 other agencies in 9 provinces. Projects are divided into categories consisting of farm production energy conservation, food industry energy conservation, solar energy, energy from biomass, and greenhouse energy. Each summary includes objectives, a summary of the results, the contractor, project leader, and project cost. 36 refs.

45399 (ANL/CNSV–65) **Carbon dioxide from flue gases for enhanced oil recovery.** Sparrow, F.T.; Wolsky, A.M.; Berry, G.F.; Brooks, C.; Cobb, T.B.; Lynch, E.P.; Jankowski, D.J.; Walbridge, E.W. Argonne National Lab., IL (USA). Jun 1988. 91p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract W-31109-ENG-38. Order Number DE89014017/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report summarizes research to design and develop a new method for recovering carbon dioxide from flue gases. The carbon dioxide could be used to enhance oil recovery from domestic oil fields. The method would also recover oxides of sulfur and nitrogen, avoiding the emission of these compounds to the atmosphere. The method is now ready to be scaled up for commercial use. When economic incentives are provided for gas recovery either through higher oil prices or the passage of national legislation on acid rain or the greenhouse effect, the research summarized here will make possible the widespread availability of highly concentrated carbon dioxide. In the near term, small ventures may use the method wherever additional carbon dioxide is needed and scarce (e.g., in the Northeast) and a combustor is suitably located. 110 refs., 26 figs., 20 tabs.

45400 (CONF-881296–Summ.) **Research and development opportunities in supercritical fluid technology: Final report.** EA-Mueller, Inc., Baltimore, MD (USA); Energetics, Inc., Columbia, MD (USA). Aug 1989. 24p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC01-87CE40762. From Workshop on research and development opportunities in supercritical fluid technology; 2 Dec 1988. Order Number DE89015320/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

On December 2, 1988, the US Department of Energy (DOE) held a workshop on supercritical fluid technology. The purpose of this workshop was to elicit research ideas from participants representing government, industry, and academia. A special concern was to determine the appropriate level of involvement for DOE and other organizations in order to develop commercial supercritical fluid technology. Group presentations and a general discussion were held to summarize the results. Comments on the general roles of DOE and industry in supercritical fluid R&D included: some industries (e.g., food processing) are already researching this technology; DOE should cooperate with industry in attempting to demonstrate this technology; and direct support of private-sector projects by DOE should be encouraged. It was also noted that productivity benefits may outweigh energy conservation benefits in some application areas. 1 fig., 5 tabs.

45401 (CONF-8504343–) **Large heat pumps for heat recovery in industrial companies.** Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. 63p. (In German). From 7. Frigen forum; 26 Apr 1985. Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The 7th Frigen Forum revealed the excellent operating results which heat pumps can achieve in specific applications thus recommending them to industrial planners and operators to include this technology in their investment schemes to a much greater extent. The eight papers held at this Forum were titled: the energy-economics significance of the industrial heat pump; industrial heat pumps; industrial heat pumps in chemical engineering; industrial heat pumps with gas-engine drive; heat pumps for drying processes; drives for industrial heat pumps; screw-type condensors in high-temperature heat pumps (scope and limits of application) plant-technology prerequisites for the integration of heat pumps in production plants. Each of the eight papers was abstracted for entry into the data base. (HWJ).

45402 (CONF-8504343–, pp. 6-10) **The energy-economics significance of the industrial heat pump.** Steimle, F. (Essen Univ. (Gesamthochschule) (Germany, F.R.). Inst. fuer Angewandte Thermodynamik und Klimatechnik). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies*. Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The step rise of heat pump application in the heating, ventilation and air-conditioning of buildings (1973 oil crisis, soaring oil prices) was followed by a decline which seemed to be just as unremitting. Based on the discussion of the energy price and today's situation of

space heating (heat requirement), the author deals with the industrial heat pump implying its main problem for its introduction, i.e. payback times, and a subdivision of energy into exergy and anergy. Energy recovery from industrial waste heat (heat exchanger) is discussed with special reference to the thermodynamic cycle process (exergy separation process, thermodynamic efficiency, performance number, refrigerating machine). In conclusion, the author points out that there is a sufficient number of applications available in industry for enhanced saving of primary energy. (HWJ).

45403 (CONF-8504343–, pp. 11-17) **Industrial heat pumps.** Kruse, H. (Hannover Univ. (Germany, F.R.). Inst. fuer Kaeltetechnik und Angewandte Waermetechnik). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies.* Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The difficulties in the introduction of industrial heat pumps are associated with the demand for the lowest investment costs and highest energy savings possible although energy savings can be expected to be almost 10%. Industrial heat pumps must be able to achieve temperatures up to 120^{0}C. The author provides data on the economical operation and modes of operation of industrial heat pumps (circuit diagram) and on condenser types for refrigerating systems. He discusses the significance of heat pumps featuring either electric drive or IC engine drive and considers investment cost of industrial heat pump components (engine/motor, compressor/condensor, heat exchanger) by means of diagrams. The EC programme provides for the development of refrigerants for high condensation temperatures as well as for studies on the application of refrigerant mixes and the behaviour of lubricants in such heat pumps. (HWJ).

45404 (CONF-8504343–, pp. 18-24) **Industrial heat pumps in chemical engineering.** Schnitzer, H. (Technische Univ., Graz (Austria). Inst. fuer Verfahrenstechnik). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies.* Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Increased application of heat pumps in chemical engineering calls for an improved integration of the heat pump with the industrial process and for recovered heat to be made available as either low pressure or medium pressure steam. The author discusses required development activities, provides data on the technical framework conditions for heat pumps in industrial processes (conversion-type/absorption-type heat pumps, heat transformers) and the characteristics of the market for heat pumps in chemical engineering (process-integrated heat generation, high-temperature heat pump, diagram: temperature levels for sources and sinks, cooling, distribution of performance variable). The author lists thermodynamic and economic criteria, economic framework conditions for industrial heat pumps and the market for heat pumps in chemical engineering (investment volumes) as well as system-technology and apparatus-related requirements made on profitable industrial heat pumps. (HWJ).

45405 (CONF-8504343–, pp. 27-32) **Industrial heat pumps with gas engine drive.** Steinbrecher, G. (Linde A.G., Koeln (Germany, F.R.). Werksgruppe Kaelte- und Einrichtungstechnik). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies.* Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Next to combined generation of heat and cold, industrial heat pumps can also be applied for profitable recovery of waste heat. The author gives two examples for these applications: the first concerns the heat supply systems of a dairy plant involving a gas-engine heat pump (construction project; energy centre: heat pump unit, circuit diagram, performance data, additional energy use, heat distribution and control, profitability); the second example concerns a combined refrigerating and heating system for a plastic processing plant. Data are given on plant structure (circuit diagram), cold-water and heating circuits, control and profitability (table: investment and operating costs). (HWJ).

45406 (CONF-8504343–, pp. 33-39) **Heat pumps for drying processes.** Boelzle, R. (Brown Boveri-York Kaelte- und Klimatechnik G.m.b.H., Mannheim (Germany, F.R.)). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies.* Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The author uses four examples complete with circuit diagrams, graphs and tables to demonstrate the application of heat pumps for a reduction of energy cost which are usually high in drying processes: wood drying (air/air heat exchanger; 40 to 50^{0}C); green malt drying (cross-flow heat exchanger; 80 to 85^{0}C); paper drying (air/air heat exchanger; 100^{0}C); the fourth example (industrial heat pump for mass drying) is dealt with in greater detail providing data on conventional air dehumidification using electric-motor and gas-engine pumps and chemical absorption (energy balance of air drying, equipment, gas-engine turbo unit). (HWJ).

45407 (CONF-8504343–, pp. 40-51) **Drives for industrial heat pumps.** Ganter, E. (Sulzer-Escher Wyss G.m.b.H., Lindau (Germany, F.R.)). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies.* Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

A great number of performance and characteristics diagrams, energy flowsheets, flow circuit diagrams, cross-sectional drawings of systems and turbines are used to provide a survey on the features and properties of different drive machines for heat pumps and to illustrate their interaction with heat pump condensers and compressors (piston, screw, turbo). Data are given on the control behaviour of condensers/compressors, electric motors (pole-changing, speed-control, efficiency), gas and diesel engines (mode of action; efficiency, fuels, system technology, maintenance, catalytic converters), steam turbines (design, configuration, control) and of gas turbines (mode of action, efficiency, utilization, waste heat, control, maintenance). In conclusion, the author gives examples for plants and systems (in-company heat machine, district-heating centre, process-cold production and heat pump). (HWJ).

45408 (CONF-8504343–, pp. 60-62) **Plant technology prerequisiters for the integration of heat pumps in production plants.** Paul, J. (Sabroe Kaeltetechnik GmbH, Flensburg (Germany, F.R.)). Hoechst A.G., Frankfurt am Main (Germany, F.R.). 1985. (In German). From 7. Frigen forum; 26 Apr 1985. In *Large heat pumps for heat recovery in industrial companies.* Order Number DE89915034/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The author provides a list of items (can also be used as checklist) pertinent to a planned integration of a heat pump in a production plant. Items are grouped into: economic aspects (investment cost, operating and maintenance cost, energy cost, profitability, service life, profitability of alternative supply strategies, future aspects); operational aspects (available driving energy, alternative supply strategies, available or required connection values or powers, peak loads emergency operation, failure risk, availability of operating and maintenance staff; adaptation of operational sequences, instrumentation and control, operational optimization, psychological aspects during operation) and planning and technical aspects (detection and recording of actual and set states, consideration of technical and physical laws, implementations, alternatives, strategic and energetic optimization, consideration of application limits, assessment of partial-load operation). (HWJ).

45409 (CONF-8806404–, pp. 30-38) **Heat recovery in indoor swimming pools.** Leisen, K. (Rheinisch-Westfaelisches Elektrizitaetswerk A.G., Essen (Germany, F.R.). Abt. Anwendungstechnik). Institut fuer Solarenergieforschung m.b.H. (ISFH), Hannover (Germany, F.R.); Gesellschaft zur Foerderung der Heizungs- und Klimatechnik m.b.H. (GFHK), Hilden (Germany, F.R.). Zentralstelle fuer Solartechnik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Projektleitung Biologie, Oekologie, Energie; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. (In German). From Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988. In *Efficient use of solar energy in solar heated swimming pools.* Order Number

DE89914827/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Measurements carried out in the indoor swimming pool at Schwalmtal proved that heat recovery systems can cover between 40 and 80% of the heat demand of certain sectors. Compared to similar pools the energy consumption of the pool mentioned above could be reduced to 40% by using an energy concept which includes heat recovery. The concept and the measurements of heat recovered from shower-pool and filter rinsing water as well as from humid air in the pool and shower rooms are explained and documented in detail. Economic aspects of heat recovery are dealt with in conclusion. (BR).

45410 (EGG-EP–8486) **The recovery of volatile organic compounds.** Priebe, S.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). Apr 1989. 14p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. Order Number DE89016360/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this study was to compare the use of Brayton cycle heat pump technology with conventional technologies for the recovery of volatile organic compounds (VOCs) from gas streams. The US Department of Energy (DOE), Office of Industrial Programs has the responsibility to promote the reduction in industrial energy use. The loss of solvents through evaporation from industrial processes represents a significant energy loss and environmental concern. To reduce these problems, DOE has funded the development of a Brayton cycle heat pump capable of removing and recovering a wide range of VOCs. To better understand how the Brayton cycle system compares with conventional VOC recovery technologies, EG&G Idaho, Inc. performed a study of the physical characteristics and the economics of the various systems. This report presents findings from that study. The technologies studied include thermal oxidation, catalytic oxidation, adsorption, condensation by Rankine cycle, and condensation by Brayton cycle. Characteristics of VOCs including, volatility, concentration, miscibility, stability, and value were discussed relative to their impact on the various removal/recovery technologies. Results showed that each technology has a place in the overall field of VOC removal and that no technology is suitable for all cases. 14 refs., 2 tabs.

45411 (EMR/MS–8602) **Characterization of Canadian fly ash and their relative performance in concrete.** Carette, G.G.; Malhotra, V.M. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mineral Sciences Labs. 1986. 58p. (MICROLOG–87-01191). Available from Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $5.00; OTHER COUNTRIES $6.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Eleven Canadian fly ashes were characterized and evaluated for their relative performance in concrete. Characterization included the determination of mineralogical composition, chemical composition, physical characteristics, and pozzolanic properties. The relative performance of each fly ash in concrete was evaluated through determination of the following properties of fresh and hardened concrete: slump, air content, bleeding, setting time, strength, modulus of elasticity, drying shrinkage, creep, and freezing-and thawing resistance. The results indicate a wide range of chemical, physical, and pozzolanic properties for the fly ashes investigated. In spite of this, all the fly ashes evaluated are shown to be suitable for use in concrete. They affect, however, the properties of fresh and hardened concrete in different ways, and this should be taken into account when proportioning concrete containing these fly ashes. 26 refs., 11 figs., 19 tabs.

45412 (FRNC-TH–2821) **Contribution to the optimal synthesis of heat exchanger networks: computer programs proposition.** Jabali, S. Ecole Centrale des Arts et Manufactures, 92 - Chatenay-Malabry (France). Jul 1984. 80p. (In French). Order Number DE89764079/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Several calculation methods for the design and optimization procedures of heat exchanger networks are presented and analyzed. Their characteristics and performances are compared. Some potential enhancements are proposed, essentially concerning the combination of technical, economical and user satisfaction optimizations. Two software programs are proposed: OPTNET and RESECH. Utilization examples are described (chemical industry).

45413 (OH/RD–88-52-K) **Drying of refractory liner boards.** Cave, T.B. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 15p. (MICROLOG–89-02552). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Laboratory tests have been done to assess the feasibility of using microwaves to manufacture refractory liner boards as used in the steel industry. Results show that microwaves cured and dried the product about ten times faster than the conventional gas-oven process. The quality of boards dried with microwaves appears to be as good or better than of those dried with gas. The potential for fast, energy-optimized drying in a small space has been demonstrated. Economically, the energy-cost of using microwaves is comparable to using gas when drying the last 30% moisture content, that is, for about the last 50% of the present gas-drying time. For higher moisture contents, such as encountered in the early stages of drying, the energy can be supplied at a lower cost by gas. 8 figs.

45414 (OH/RD–88-74-K) **Heat pump technologies for industrial applications.** Peters, D.M.; Adams, R.J. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 45p. (MICROLOG–89-02642). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report outlines the various forms of closed-cycle heat pumping technologies being researched for use in high temperature industrial applications. The two major classifications of heat pump technologies described in this report are mechanical and chemical heat pumps. Some current applications of high temperature industrial heat pumps are also outlined. 27 refs., 29 figs.

45415 (OH/RD–88-81-K) **DC furnace technology in the metallurgical industry.** Reesor, R.A.; Bergman, R.A.; Pearce, F.; Whitmell, H.E. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 93p. (MICROLOG–89-02580). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Ontario Hydro Research Division out a state-of-the-art study on DC arc furnace technology. Two consultants were employed to cover the ferrous and the non-ferrous industries. The study is based on a review of the literature, information gained through visits made to DC furnace operations, and on discussion with furnace suppliers and others knowledgeable in the field of electric furnaces technology. The main indicated advantages of the DC over the AC arc furnace in the steel industry are reduced electrode and refractory consumption as well as lower disturbance on the power grid. To date no advantage of DC over AC operation has been demonstrated in the non-ferrous industry, primarily since this industry has done little investigative work on DC technology. The metallurgical industry in Ontario is receptive to the adoption of DC technology if economic benefits can be demonstrated. At present, three commercial DC steel making arc furnaces are operating in the western world, two in the U.S. and one in France. The only non-ferrous commercial DC operation is located in South Africa and is producing high carbon ferrochrome. 67 refs., 15 figs., 11 tabs.

45416 (OTIFBI–1987) **Environmentally acceptable disposal of wastes from vegetable processing industries.** Papdopol, C.S.; Nolah, J.D. Ontario Tree Improvement and Forest Biomass Inst., Maple, ON (Canada); Ontario Ministry of Natural Resources, Aylmer, ON (Canada). Forestry Branch. 1987. 15p. (CONF-8709463–: Food processing waste conference, 1 Sep 1987; MICROLOG–89-02370). Available from Canada Dept. of Fisheries and Oceans, Scientific Publications, 200 Kent St., 14th Floor, Ottawa, ON, CAN K1A 0E6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The environmental soundness of waste disposal practives is already a major concern of industrialized societies. For wastes with low heavy metals content originating from vegetable processing industries, recycling through intensive silviculture seems to offer an almost ideal solution. Starting from the continuous need of trees for water and nutrients during the growing season, various designs involving optimized supply of trees with their living necessities, can be visualized. However, in order to quickly achieve effectiveness, the intensive silviculture of monoclonal stands of fast growing species appears irreplaceable. Such areas can be irrigated with rates equivalent to daily atmospheric demand for evapotranspiration, thus aiming at a zero percolation rate. Intensive silviculture combined with fast growing hybrid poplars and willows has been applied for the disposal of effluent resulting from the operation of Cobi Foods in London, Ontario (frozen peas and corn during summer, french fries during winter). This paper provides information about the survival and growth performances of the poplar clones included in the experiment, as well as some results with respect to renovation efficiency of the system. Other design concepts involving fast growing species are discussed together with preliminary criteria for clone selection. 11 refs., 2 tabs.

45417 (PB–89-197131/XAB) **Refining the degree of hazard ranking methodology for Illinois industrial waste streams.** Plewa, M.J.; Minear, R.A.; Ades-McInerney, D.; Wagner, E. Illinois Univ., Urbana, IL (USA). Inst. of Environmental Studies. Nov 1988. 119p. Available from NTIS, PC A06/MF A01.

This research was a continuation of the project entitled 'Assigning a Degree of Hazard Ranking to Illinois Waste Streams' (Plewa et al., 1986). Currently, the Illinois Pollution Control Board is mandated to implement a degree of hazard system to evaluate Illinois Special Waste Streams by December 1989. The objectives of this project were (1) to define a rational and empirically defendable foundation for the accumulative toxicity scoring graphs, (2) to transfer the database management system for degree of hazard evaluation from R: Base 5000 to R: Base System V, (3) to generate a series of interactive menu templates for entering data and conducting the degree of hazard evaluation, and (4) to devise a formal procedure to employ national toxicology and chemical data bases for the periodic revision of the HWRIC Degree of Hazard Data base.

45418 (PB–89-209829/XAB) **Superfund Record of Decision (EPA Region 4): Independent Nail, Beaufort, Beaufort County, South Carolina (second remedial action), August 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 8 Mar 1988. 69p. (EPA/ROD/R–04-88/040). Available from NTIS, PC A04/MF A01.

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The Independent Nail site, occupying 24.6 acres, is located near the town of Beaufort, South Carolina. The Black and Johnson Company, previous owners of the site, manufactured metallic screws and fasteners. As part of the manufacturing process, the company discharged approximately 33,000 gallons per day of plating wastewater into an unlined infiltration lagoon. The discharge rate may have been as high as 75,000 gallons per day. The lagoon was in use from approximately 1969 to 1980. The South Carolina Department of Health and Environmental Control reported that waste water contained some organic cleaning solvents and metals. The primary contaminants of concern include chromium, zinc and cyanide.

45419 (PNL–6935) **Potential industrial applications for composite phase-change materials as thermal energy storage media.** Spanner, G.E.; Wilfert, G.L. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 44p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. Order Number DE89015170/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Considerable effort has been spent by the US Department of Energy and its contractors over the last few years to develop composite phase-change materials (CPCMs) for thermal energy storage (TES). This patented TES medium consists of a phase-change material (typically a salt or metal alloy) that is retained within the porous structure of a supporting material (typically a ceramic). The objectives of this study were to (1) introduce CPCMs to industries that may not otherwise be aware of them, (2) identify potentially attractive applications for CPCM in industry, (3) determine technical requirements that will affect the design of CPCM's for specific applications, and (4) generate interest among industrial firms for employing CPCM TES in their processes. The approach in this study was to examine a wide variety of industries using a series of screens to select those industries that would be most likely to adopt CPCM TES in their processes. The screens used in this study were process temperature, presence of time-varying energy flows, energy intensity of the industry, and economic growth prospects over the next 5 years. After identifying industries that passed all of the screens, representatives of each industry were interviewed by telephone to introduce them to CPCM TES, assess technical requirements for CPCM TES in their industry, and determine their interest in pursuing applications for CPCM TES. 11 refs., 4 tabs.

45420 (PNL-SA–17216) **Proceedings of the International Energy Agency workshop on separation technologies.** Fassbender, L.L.; Ashton, W.B.; Kinzey, B.R.; McDonald, S.C. Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 89p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC06-76RL01830. (CONF-8801163–: International energy agency workshop on separation technologies, 25-28 Jan 1988). Order Number DE89015172/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

An international separations workshop was held to review current international research and development (R and D) activities in separation technologies and to identify important R and D needs. Participants represented government, academia, and industry from Austria, Canada, the Netherlands, Sweden, the United Kingdom, the United States, and West Germany. Workshop activities included an identification of broad areas of R and D that are needed to advance the state of the art in separations science and technology, and some of the more focused, key research efforts needed. Participants, working in groups, developed more detailed R and D recommendations and identified example projects that address knowledge gaps in three major technology areas: (1)membranes, (2) drying, evaporation, distillation, dewatering, and freeze crystallization, and (3) solvent/supercritical fluid extraction. Also, as background for the technical discussions, members of each country represented at the workshop made formal presentations.

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Refer also to citation(s) 44867, 44868, 44922, 44992, 45298, 45308, 45311, 45877

45421 (AA–8401) **Design and refitting of the Tillsonburg Water Pollution Control Plant for computer control. Phase 1, documentation report.** Anderson Associates Ltd., Willowdale, ON (Canada). 1984. vp. (CE–01746). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

The estimated costs and cash flow requirements are outlined for the refitting of a water pollution control plant in Ontario. The purpose of this project is to demonstrate strategies for improved operation and for energy savings through instrument- and computer-based control at a full-scale facility. Alterations and modifications are described which affect the pumping station, activated sludge system, aeration system, and aeration diffusion system. System schematics and cost data are included. 5 figs., 1 tab.

45422 (BFR-R–38-1989) **Exterior air and ground water source heat pump at Haellbybrunn. Evaluation.** Andersson, J.; Wetterstroem, P. Swedish Council for Building Research, Stockholm (Sweden). 1989. 202p. (In Swedish). Order Number DE89914788/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

The heat pump installation consists of an exterior air heat pump (2x1.25 MW) and a ground water heat pump (1.7 MW). The ground water comes from a gravel ridge and is utilized as heat source primarily during the winter half-year. During summer the ridge is reloaded with water that is circulated via a solar heated pond. The heat pumps are connected to the district heating system supplying an area with very varied housing estate, such as dwellings, a home for aged people, a market garden and industry. The availability of

the heat pumps has been considerably lower than planned because they have not received the intended operation bases. The reason for this is that high district heating temperatures, superimposed control systems etc. deteriorated and at times made heat pump operation impossible. The report points out the importance of all peripheral systems affecting the heat pump to be within the frames of the heat pump operation sphere.

45423 (ETDE/CA-MS–83-02) **Super energy efficient housing and solar orientation. A research report.** Department of Energy, Mines and Resources, Ottawa, ON (Canada). 1983. 32p. (CE–02757). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages.

A study was conducted in Canada to assess the additional land and the benefit resulting from planning and development to give solar orientation to subdivision lots. The study also investigated the costs of equipping a standard house to achieve the maximum benefit of solar radiation, and assessed the useful solar contribution of houses built according to various efficiency standards. This study concludes that it appears generally feasible to design new subdivisions to give solar access to a majority of lots with little or no extra cost for land or for services. This conclusion is not true for odd-shaped parcels of land with poor orientation or with other militating constraints. Also, there is some advantage to arranging super-energy efficient (SEE) housing to obtain maximum solar gain in solar subdivisions; but with cost factors to consider, this advantage is not great enough to justify any but the simplest arrangements, such as distribution of glazing to obtain maximum solar gain. There is some justification for placing glazing to maximize solar contribution in homes built to standards inferior to those of SEE houses. However, the usable solar gain – while higher than in a SEE house – becomes a very small fraction of the total heat load. Apart from considerations of energy conservation, solar access for a majority of homes in a subdivision has considerable market value, since sunspace, green-houses, clerestory windows and skylights are demonstrably effective as selling features. 9 refs., 7 figs., 4 tabs.

45424 (NEI-DK–196) **Technology regulations for district heating delivery. DFF-vejledning.** Danske Fjernvarmevaerkers Forening, Kolding (Denmark). Sep 1988. 49p. (In Danish). Order Number DE89914672/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The Danish Board of District Heating in Denmark has produced a set of recommendations to be used as the basis of agreements between the consumer and the supplier of district heating. The recommendations concern the field of application, the connecting up, operation and installation of district heating systems with emphasis on technology. (author).

45425 (PB–89-197107/XAB) **Participation in a household hazardous-waste collection drive and 'before' and 'after' public knowledge and disposal practices: Champaign County. Technical report.** Liebert, R.J. Illinois Univ., Urbana, IL (USA). Survey Research Lab. Feb 1989. 375p. Available from NTIS, PC A16/MF A01.

The extent to which households use, store, and dispose of hazardous materials has become a matter of increasing concern but has rarely been assessed. The project report provides an assessment of the first household hazardous materials publicity campaign and collection event held in Illinois. The collection event date was September 13, 1987, in Champaign County. The report describes survey results concerning the state of public awareness, use, and disposal of household hazardous materials prior to and immediately after the publicity campaign in Champaign County.

45426 (PB–89-211684/XAB) **Superfund Record of Decision (EPA Region 3): Middletown Air Field, Pennsylvania (first remedial action), December 1987.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 31 Dec 1987. 47p. (EPA/ROD/R–03-88/039). Available from NTIS, PC A03/MF A01.

The Middletown Air Field site covers what is now the Harrisburg International Airport (HIA), located between the town of Middletown and Nighspire, Dauphin County, Pennsylvania. The airport is owned and operated by the Commonwealth of Pennsylvania Department of Transportation. The area surrounding the base is characterized as mixed residential/industrial. Between 1898 and 1962, the property was owned by the U.S. Government and used by the military. HIA and several other entities occupy what was referred to as the Olmsted Air Force Base. In March 1983, TCA contamination caused six of the ten onsite production wells supplying HIA to be taken out of service. Studies initiated under the Department of Defense Installation Restoration Program indicate that while ground-water contamination due to volatile organic compounds exists, the exact source(s) of contamination cannot be clearly defined. Ground water contamination may result from one or more, possibly current, sources in the 'industrial area'. To date, HIA has been able to temporarily meet the water requirements of the facility by taking the most contaminated well off-line as a potable water source, and by blending potable water from a number of wells.

45427 (PB–89-865653/XAB) **Sewage-treatment costs and economics. January 1979-June 1987 (Citations from the NTIS data base). Report for January 1979-June 1987.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 172p. Available from NTISPC N01/MF N01.

See also PB–89-865661.

This bibliography contains citations concerning the costs and economics involved in technology and systems for sewage treatment, sludge disposal, and sewer lines. Most of the studies cover the overall construction and operating costs of sewage-treatment plants. Other studies cover rate structures, financing, user charges, and benefits of regionalized plants. (This updated bibliography contains 348 citations, none of which are new entries to the previous edition.)

45428 (PB–89-865745/XAB) **Sewage and industrial-waste treatment: Wetlands. January 1977-July 1989 (Citations from the Selected Water Resources Abstracts data base). Report for January 1977-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 77p. Available from NTISPC N01/MF N01.

Supersedes PB–88-866470.

This bibliography contains citations concerning developments, operations, and evaluations of natural and artificial wetlands treatment of wastewater and sludge. Aquaculture treatments of industrial, municipal, and domestic waste water are examined. Topics include nutrient removal, heavy metal recovery, and case studies of wetlands being used for waste water treatment. (This updated bibliography contains 112 citations, 19 of which are new entries to the previous edition.)

45429 (SI-R–8512203-3) **Incineration of household waste with biomass as additive fuel.** Benestad, C.; Jebens, A.; Tveten, G. Senter for Industriforskning, Oslo (Norway). Apr 1988. 23p. (In Norwegian). Order Number DE89914765/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Pollutions in exhaust gas from household waste and biomass incineration have been analyzed. The purpose of the study was to determine whether the use of biomass as additive fuel for waste incineration would improve combustion efficiency and hence reduce discharge from the incineration. The investigation is a follow up of a previous study which analyzed discharges of organic micropollution from the same incinerator. Pure waste was burnt hence giving a basis for direct comparisons in this study. An improvement in the traditional sence was obtained by incinerating waste together with biomass. Discharges of polyaromatic hydrocarbon compounds (PAH) and other aromatic compounds were markedly reduced, but discharges of oxygen containing compound increased. Whether discharge of chlorinated organic compounds was generally altered is uncertain, but the polychlorinated dibenzofuranes (PCDF) and polychlorinated dibenzo-p-dioxines (PCDD) concentrations seem unaltered. Dust discharge was not reduced by adding biomass to the waste. The Ames' mutagenicity test was used on the flue gas samples and the mutagen content was lower than for many household wood burning ovens and stoves. Content of mutagens, total clorine and heavy metals were not tested in the previous study. But since chlorine and heavy metal discharges are directly connected to the fuel content it is likely that incineration of waste added biomass does not reduce these discharges. 9 tables, 3 figures.

45430 (VTT-TIED–963) **Training simulator for district heating system.** Katajisto, K.; Kohonen, R.; Jalonen, O. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Mar 1989. 89p. (In Finnish). Order Number DE89787761/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Simulation is a tool for getting better understanding of performance of dynamic systems. New applications of simulation are testing emulators and training simulators. A training simulator for district heating system has been realized in PC/AT-environment. It is used in training engineers responsible to building services. The training simulator demonstrates the performance and interconnections of a building, its heating and ventilation system, heating plant and the control system as a whole. The training simulator consists partly of physical devices and partly of numerical models. The heating plant consists of normal heat exchangers on the market. The district heating network is 'eplacedby an electrical boiler with necessary control system. The loads for heating and ventilation are calculated with numerical models. The entire system has six coupled control loops, which have been realized with digital PI-algorithms. The choice of control law is based on step-response tests. In the research report the tuning of the coupled control system as well as the performance of the system as a whole is discussed.

3209 Education and Public Relations

Refer also to citation(s) 45212, 45213, 45214

45431 (BLRL–8804) **Survey of public attitudes towards energy conservation. Research recommendations.** Baseline Market Research Ltd., Fredericton, NB (Canada). 1988. 6p. (MICROLOG–89-02884). Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The following recommendations represent the research firm's interpretation of actions that seem appropriate for energy conservation, given the information collected in this study of New Brunswick homeowners. The information collected suggests that the Dept. of Natural Resources and Energy has a difficult task to promote energy conservation. Many homeowners believe that they have accomplished the basics needed to conserve energy and further savings may not be worth the investment. It is suggested that the expression "energy conservation" be replaced by "energy efficiency" or any other energy-value terminology. Means are suggested to disseminate energy conservation information. Given the customers' underlying lack of motivation, little benefit can be gained from passive services; the government should become a more aggressive promoter of the need for the efficient use of energy resources.

45432 (BLRL–8804) **Survey of public attitudes towards energy conservation.** Baseline Market Research Ltd., Fredericton, NB (Canada). 1988. 146p. (MICROLOG–89-02883). Available from New Brunswick Dept. of Natural Resources and Energy, P.O. Box 6000, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A survey was conducted in New Brunswick in 1987, with the following objectives: to determine the rank of energy costs and conservation with respect to other social or economic issues; to determine the barriers to energy conservation; to assess motivational factors, awareness of specific activities, and level of homeowner's knowlege; to identify the consumer's sources of information on energy conservation and determine the consumer's perception of the adequacy of this information; and to determine the level of support for government's role in providing information on energy conservation. A 3-stage research approach was implemented, consisting of secondary research, a province-wide telephone survey of 600 households, and the use of focus groups in Fredericton, Moncton, and Edmunston. The conclusions of this survey are discussed. The survey suggests that government's role in energy conservation should be directed at keeping the public informed, and at keeping the interest and awareness at an adequate level to ensure the efficient use of our energy resources. 16 refs., 39 tabs.

45433 (CNBA–1988) **Energy Educators of New Brunswick annual report, 1987-1988.** Hunt, S. Canada/New Brunswick Agreement on Conservation and Alternative Energy Activities, Fredericton, NB (Canada). 1988. 67p. (MICROLOG–89-03076). Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Energy Educators of New Brunswick is an information network of volunteer members formed in the summer of 1984 whose purpose is to advance the teaching of energy education in the province of New Brunswick. This annual report gives details of the activities carried out during the year, including an energy conservation calendar competition, a symposium and annual general meeting, the publication of 3 newsletters, and the introduction of a pilot version of the Strategem 1 game, a simulation game used to illustrate how changes in energy affect the rest of the economy. A financial statement and minutes of the Steering Committee meetings are also included.

33 ADVANCED AUTOMOTIVE PROPULSION SYSTEMS

Refer also to citation(s) 45394, 45395

3301 Internal Combustion Engines

Refer also to citation(s) 45450

45434 (AD-A–207754/3/XAB) **Study of an advanced variable-cycle diesel as applied to an RPV (remotely piloted vehicles). Final report, 11 August 1988-28 February 1989.** Johnston, R.P. Dieseldyne Corp., Morrow, OH (USA). 1 May 1989. 85p. (DDC–89-01). Available from NTIS, PC A05/MF A01.

A variable-cycle diesel is examined for use in an unmanned long-endurance RPV. Engine-configuration studies are made and a possible installation arrangement developed. Installed performance projections are made, and a long endurance RPV mission fuel, installed engine weight and propeller performance estimates made along with several aircraft-installation drawings. It was found that the final engine configuration performed the specified mission with a total fuel and installed engine weight fraction of only 24% of the vehicle Take Off Gross Weight. The mission was evaluated at a cruise altitude of 65000 feet and an engine configuration suitable for use at 85000 feet was also investigated.

45435 (DOE/CE–0257) **Advanced Turbine Technology Applications Program, (ATTAP): A plan for improving the prototype production of ceramic components for the gas turbine engine, 1988–1992.** USDOE Assistant Secretary for Conservation and Renewable Energy, Washington, DC (USA). Office of Transportation Systems. Apr 1989. 18p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE89015566/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This Advanced Turbine Technology Applications Project (ATTAP) Plan, which was developed with inputs from industry, NASA and ORNL is intended to advance the technological readiness for commercialization of an automotive ceramic gas turbine engine, the feasibility of which was established and demonstrated during the recently concluded AGT Project. 3 refs., 10 figs., 2 tabs.

45436 (DOE/CE/50111–H1) **Advanced turbine technology applications program, (ATTAP): An overview of complementary activities on ceramic materials within the Allied-Signal Corporation and the General Motors Corporation which provide synergistic benefits to the ATTAP program, 1988–1992.** Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Apr 1989. 12p. Sponsored by U.S. DOE Conservation & Renewable Energy. Order Number DE89016067/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A significant level of Research and Development and product development activities on ceramic materials is being carried on by the General Motors Corporation and the Allied-Signal Corporation, the

parent companies of the ATTAP contractors, Allison Gas Turbine Division and Garrett Auxiliary Power Division, respectively. In continuing the automotive gas turbine program with both Allison and Garrett in the application of high temperature structural materials in advanced automotive gas turbine engines it was the intention of the Department of Energy to not only provide encouragement to these companies to continue their activities on ceramic materials which are providing important synergistic benefits to ATTAP but also to signal the developing US ceramics industry of a continuing commitment to this program by important elements of the gas turbine industry and the automotive industry. 5 figs.

45437 (DOE/NASA–0168-11) **Advanced Gas Turbine (AGT) Technology Project: Final report.** National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center; General Motors Corp., Indianapolis, IN (USA). Allison Gas Turbine Div. Aug 1988. 188p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AI01-85CE50111. DEN 3-168. (NASA/CR–182127;EDR–13295). Order Number DE89016022/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This final report provides overall summary documentation of the Advanced Gas Turbine Technology Project conducted by the Allison Gas Turbine Division of General Motors Corporation under contract to the NASA-Lewis Research Center (contract DEN3-168). Funding and sponsorship of this project came from the Heat Engine Propulsion Division, Office of Transportation Systems, in the Office of Conservation and Renewable Energy of the Department of Energy (DOE). This program's period of performance (technical) spanned October 1979 through June 1987. This document especially emphasizes program activities during 1986 and 1987; earlier semiannual and annual reports, listed as references, present further details of earlier years. 12 refs., 228 figs., 57 tabs.

45438 (DTH-LET-NE–88-3) **Internal combustion engine. Fuel feed and power control.** Kofoed, E.; Sorenson, S.C. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Energiteknik. 1989. 62p. (In Danish). Order Number DE89914639/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Control of the efficiency of an internal combustion engine is highly dependent on the nature of the fuel-feeding system. This statement is elaborated in detail and with the help of equations, graphs and diagrams. Recommended fuel-air conditions for petrol driven motors are explained as are also methods for obtaining the correct combination of fuel and air with regard to the carburator and the injection of petrol or diesel oil. (AB) 10 refs.

45439 (ETDE-mf–9914823) **Exhaust gas emissions from engines of motorcycles.** Weber, H.; Richter, A.; Klinkemeyer, W. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Pruefstelle fuer die Abgase von Kraftfahrzeugen; Umweltbundesamt, Berlin (Germany, F.R.). Apr 1986. 112p. (In German). Contract UFOPLAN-Nr. 10405506. Order Number DE89914823/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Ten motorcycles were tested at a time according to the requirements of the ECE-regulations 40 and 47 with regards to their exhaust gas emissions. Beside the gaseous emissions CO, CH and NO_x the particulate bounded PAH were measured. Additional the gaseous emissions at constant speed were investigated, more over the influence of different variations to the exhaust gas emissions. The measurements showed, that the emissions of modern motorcycles are in most cases lower than the limits. The determination of the PAH proved higher emissions of carcinogenic PAH-components from the two stroke engines than from four stroke engines. The determination of the exhaust gas components at constant speeds showed for the ECE-regulation 47 motorcycles at maximum speed due to the decrease of air-fuel-ratio the tendency for a great increase of CO-emission and a less distinct increase of HC-emission. The determination of the exhaust gas components at the variations showed a strong interdepencence of the exhaust gas emissions from the choice of the gearshifting points and the adjustment of idle-CO. (orig.) With 14 tabs., 27 refs., 48 figs.

45440 (ETDE-mf–9914838) **Production processes of ceramic turbine wheels suitable for a car gas turbine. Final report.** Moergenthaler, K.D.; Buehl, H.; Heinze, R.; Hempel, H.; Herold, T.; Hoffmann, J.; Jungbauer, L.; Stute, M.; Sulzbacher, G.; Weisner, R. Daimler-Benz A.G., Stuttgart (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1989. 200p. (In German). Contract BMFT 03 ZC 083 6. Order Number DE89914838/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The objective of the research project was to develop turbine wheels for application in a car gas turbine with turbine inlet temperatures up to 1350°C using processes suitable for volume production. The research project included: Designing a new turbine wheel made from sintered or hiped silicon nitride at Daimler-Benz, Development of an injection mold, Development of an slip casting and injection molding process suitable for the production of turbine wheels at the Max-Planck-Institut, Stuttgart, and GTE, USA, Manufacturing of injection molded turbine wheels made of silicon nitride, Determination of the relevant material data e.g. at University Karlsruhe, Testing the finished turbine wheels. Injection molded turbine wheels which were largely free from faults have been manufactured. Two of these turbine wheels survived cold spin testing up to 84.600 rpm. One injection molded turbine wheel has been tested under turbine conditions for 10 hours, for 9 hours out of these at 1250°C and 61.500 rpm. (orig.) With 28 refs., 22 tabs., 156 figs.

45441 (LA-UR–89-2403) **Homogeneous catalysts in hypersonic combustion.** Harradine, D.M.; Lyman, J.L.; Oldenborg, R.C.; Pack, R.T.; Schott, G.L. Los Alamos National Lab., NM (USA). 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8909120–2: American Physical Society (APS) meeting, 5-8 Sep 1989). Order Number DE89015258/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Density and residence time both become unfavorably small for efficient combustion of hydrogen fuel in ramjet propulsion in air at high altitude and hypersonic speed. Raising the density and increasing the transit time of the air through the engine necessitates stronger contraction of the air flow area. This enhances the kinetic and thermodynamic tendency of H_2O to form completely, accompanied only by N_2 and any excess H_2(or O_2). The by-products to be avoided are the energetically expensive fragment species H and/or O atoms and OH radicals, and residual ($2H_2$ plus O_2). However, excessive area contraction raises air temperature and consequent combustion-product temperature by adiabatic compression. This counteracts and ultimately overwhelms the thermodynamic benefit by which higher density favors the triatomic product, H_2O, over its monatomic and diatomic alternatives. For static pressures in the neighborhood of 1 atm, static temperature must be kept or brought below ca. 2400 K for acceptable stability of H_2O. Another measure, whose requisite chemistry we address here, is to extract propulsive work from the combustion products early in the expansion. The objective is to lower the static temperature of the combustion stream enough for H_2O to become adequately stable before the exhaust flow is massively expanded and its composition "frozen." We proceed to address this mechanism and its kinetics, and then examine prospects for enhancing its rate by homogeneous catalysts. 9 refs.

45442 (UBA-FB–89-020) **Emission factors of fuel evaporative emissions from gasoline powered cars.** Umweltbundesamt - Texte. Heine, P.; Baretti, A. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Pruefstelle fuer die Abgase von Kraftfahrzeugen; Umweltbundesamt, Berlin (Germany, F.R.). Feb 1989. 130p. (In German). Contract UFOPLAN-Nr. 10405149. Available from Copy held by UB/TIB Hannover.

Because of temperature- and herewith pressure-changes in the fuel system from gasoline powered cars evaporative emissions take place. The amount of the emissions depends essentially on the actual difference in temperature and also on the composition of the fuel. A test-procedure to determine the evaporative emissions has been worked out. The emission factors were determined by using a specific calculating model. The prediction is based on the results of tests carried out with a representative random sampling. For the FRG a fuel evaporation emission (without refuelling emissions) of about 250 000 t a year has been found. (orig.).

45443 **Measuring alignment of loading fixture.** Scavone, D.W. To Dept. of Energy, Washington, DC. USA Patent 4,827,773. 9 May 1989. Filed date 10 Mar 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

An apparatus and method for measuring the alignment of a clevis and pin type loading fixture for compact tension specimens include a pair of substantially identical flat loading ligaments. Each loading ligament has two apertures for the reception of a respective pin of the loading fixture and a thickness less than one-half of a width of the clevis opening. The pair of loading ligaments are mounted in the clevis openings at respective sides thereof. The loading ligaments are then loaded by the pins of the loading fixture and the strain in each loading ligament is measured. By comparing the relative strain of each loading ligament, the alignment of the loading fixture is determined. Preferably, a suitable strain gage device is located at each longitudinal edge of a respective loading ligament equidistant from the two apertures in order to determine the strain thereat and hence the strain of each ligament. The loading ligaments are made substantially identical by jig grinding the loading ligaments as a matched set. Each loading ligament can also be individually calibrated prior to the measurement.

3303 Electric-powered Systems

Refer also to citation(s) 45165, 45166

45444 (DOE/ID–10232) **Performance testing and system evaluation of the Soleq Evcort electric vehicle.** Crumley, R.L.; MacDowall, R.D.; Hardin, J.E.; Burke, A.F. EG and G Idaho, Inc., Idaho Falls, ID (USA). Mar 1989. 113p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC07-76ID01570. (MISC–89028). Order Number DE89016208/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report presents the results of tests performed on a direct current (dc) powertrain in a test bed vehicle (EVCORT) developed by the Soleq Corporation of Chicago, Illinois. The tests were performed by EG&G Idaho, Inc. at the Idaho National Engineering Laboratory (INEL). The purpose of the INEL testing was to provide test results from which an evaluation of the performance capabilities of the Soleq DC powertrain could be made and compared with other vehicle propulsion systems. The propulsion system efficiency was found to be comparable to the Chrysler/GE ETV-1, which is considered to have one of the most efficient propulsion systems. On a power-to-weight basis, the acceleration performance of the Evcort is essentially equivalent to that of the highest performance electric vehicles tested at the INEL. The range of the Evcort compares favorably with the majority of the electric vehicles tested at the INEL, due to both its large battery mass fraction, and its low specific energy consumption (per unit vehicle mass). The Evcort was equipped with air conditioner and heater/defroster systems, designed and manufactured by Soleq Corporation, which are powered from the main traction battery pack. The effect of operating the air conditioner on vehicle energy consumption and range was determined from dynamometer test data, and the effectiveness of the air conditioner and heater/defroster systems were assessed by conducted field tests of the vehicle under both summer and winter conditions. 6 refs., 31 figs., 18 tabs.

3304 Hybrid Systems

Refer also to citation(s) 45166, 45444

3307 Emission Control

Refer also to citation(s) 45439, 45442

45445 (EC/RRE–1989) **Vehicle emissions testing laboratory.** Environment Canada, Ottawa, ON (Canada). River Road Environmental Technology Centre. [1989]. 6p. (In English and French). (MICROLOG–89-02382). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The activities and capabilities of Environment Canada's laboratory for testing vehicle emissions are outlined. Located in Gloucester, Ontario, the laboratory tests a wide range of vehicles, emission control technologies and fuels, in order to ensure that federal emissions standards for new vehicles are being met and to assess whether vehicles continue to operate cleanly under Canadian driving conditions. In addition, the laboratory conducts tests for a variety of Environment Canada programs to assess the contribution that motor vehicles make to Canadian pollution levels and to evaluate the effects of maltuning and emission control system tampering on emissions and vehicle performance.

45446 (UBA-FB–87-091) **Round-robin test - check of the repeatability of particle mass determination.** Reichel, S. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Pruefstelle fuer die Abgase von Kraftfahrzeugen; Umweltbundesamt, Berlin (Germany, F.R.). Nov 1987. 72p. (In German). Contract UFOPLAN-Nr. 10405181/01. Available from Copy held by UB/TIB Hannover.

A round-robin test was conducted with 4 diesel vehicles in 4 European laboratories in order to check the comparability of particulate mass determinations. There were scatters (standard deviations related to the mean value) of between 23 and 42%. Since a number of deviations were established in one laboratory and, in addition, a statistical investigation led to the suspicion that some of the results from this laboratory were freak results, an evaluation was also conducted on the basis of the results from the 3 other laboratories. This evaluation reveals scatters of between 12 and 18%, which are lower than in previous round-robin tests. It can be expected that standardisation of the technical equipment in the laboratories will lead to a further reduction in the scatters and hence a further improvement in reproducibility. (orig.) With 3 refs., 48 tabs.

45447 (VTT-TIED–943) **Monetary valuation of road traffic's environmental hazards.** Himanen, V.; Maekelae, K.; Alppivuori, K.; Aaltonen, P.; Louhelainen, J. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Feb 1989. 43p. Order Number DE89787762/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The quantity of noise, exhaust emissions and dust caused by road traffic in Finland is estimated along with the monetary value of their effects. The valuations are mainly based on the estimated costs of the prevention of these hazards. In addition, the costs due to losses caused by traffic noise and exhaust emissions are estimated. The results contain a substantial degree of uncertainty. 840,000 people in Finland lived within road traffic noise zones in 1987. The number of people suffering from the noise was 208,000. The noise hazard was valuated at 1,200 million FIM in 1987 (1 FIM = 0.25 USD). In 1987, the exhaust emissions of road traffic contained 110,000 tons of nitric oxides, 310,000 tons of carbon monoxide, 30,000 tons of hydrocarbons, 6,000 tons of sulphur dioxide, 10,000 tons of solid particles, and 340 tons of lead. The exhaust emissions can be valuated at 900-4,800 million FIM in 1987, depending on the method of calculation. Traffic produced 260,000 tons of rock dust in 1987. The costs of dust prevention would have been 800 million FIM. The total annual costs of noise, exhaust emissions and dust caused by road traffic would thus amount to 3-7 billion FIM.

3308 Alternative Fuels

Refer also to citation(s) 44838

45448 (ORNL/TM–11230) **Results from the second year of operation of the Federal Methanol Fleet at Argonne National Laboratory.** McGill, R.N.; Hillis, S.L.; West, B.H.; Hodgson, J.W. Oak Ridge National Lab., TN (USA). Aug 1989. 47p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89016935/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Argonne National Laboratory has completed two full years of operation of 19 vehicles in the Federal Methanol Fleet Project; ten of the vehicles are fueled with methanol. Over one-half million miles have been accumulated on the fleet vehicles so far, and comparisons of efficiency continue to show nearly equal performance between the methanol and gasoline vehicles. Emissions tests of some of the vehicles during the second year revealed degradations of emissions control systems for both the methanol and gasoline vehicle types, although emissions were still within limits. Methanol vehicles continued to require more maintenance, and the maintenance labor intensity (hours per 1000 miles) increased for all the

vehicle types being monitored. Accumulation of metals in the lubricating oil of the methanol vehicles continued to be elevated compared to that of the gasoline vehicles although not at alarming levels. Drivers indicated less satisfaction with vehicles in the test during the second year, both for methanol as well as gasoline vehicles. 5 refs., 7 figs., 22 tabs.

45449 (PB–89-193353/XAB) **Conversion of methanol-fueled 16-valve, 4-cylinder engine to operation on gaseous $2H_2$/CO fuel. Interim report 2. Technical report.** Piotrowski, G.K.; Martin, J. Environmental Protection Agency, Ann Arbor, MI (USA). Mar 1989. 27p. (EPA/AA/CTAB–89/02). Available from NTIS, PC A03/MF A01.

Described is the conversion of a 16-valve, 4-cylinder light-duty automotive engine to operation on a mixture of hydrogen and carbon monoxide gaseous fuel. The engine was evaluated to determine the difference in emission levels and lean limit operation between two different fuels: M100 neat methanol and simulated dissociated methanol gaseous fuel ($2H_2$/CO). The engine will eventually be used as a test bed for a practical, onboard methanol dissociation fuel system. Modifications made to the test engine to enhance the characteristics of $2H_2$/CO fuel are discussed. A description of the CA18DE test engine modified for use on M100 neat methanol is also included.

45450 (PB–89-193973/XAB) **Resistively heated methanol dissociator for engine cold start assist. Interim report 2. Technical report.** Piotrowski, G.K. Environmental Protection Agency, Ann Arbor, MI (USA). Feb 1989. 24p. (EPA/AA/CTAB–89/01). Available from NTIS, PC A03/MF A01.

See also PB–88-223763.

A catalyst specifically formulated for the dissociation of methanol to hydrogen and carbon monoxide was evaluated for the application of a cold start assist for a light-duty methanol-fueled engine. The dissociated methanol-generating systems consisted of a steam-heated methanol boiler, a gas superheated, and a catalyzed dissociation element. The experiment determined the ability of the catalyst to facilitate the dissociation of methanol, and to start and idle a four-cylinder engine on the product gas from the dissociator. The dissociator operation, the equipment, the test results and the test-engine specifications are also included.

35 ARMS CONTROL

3502 Proliferation

Refer also to citation(s) 44819, 44827

36 MATERIALS

45451 (INIS-SU–111/A) **Molecular beam epitaxy. Surface. Vol. 4. Extended theses.** AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. 167p. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

Individual items are processed separately for the data base. (DLC)

3601 Metals and Alloys

Refer also to citation(s) 44425, 44611, 44724, 44988, 45025, 45030, 45036, 45066, 45067, 45071, 45156, 45572, 45574, 46020, 46573, 46589, 46609, 46614, 46615, 46619

45452 (AD-A–208107/3/XAB) **Fatigue crack growth-microstructural relationship of Ti-6Al-4V. Final report, September 1987-June 1988.** Thompson, S.R. Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA). Nov 1988. 31p. (AFWAL-TR–88-4254). Available from NTIS, PC A03/MF A01.

In a previous effort the fatigue crack-growth-rate characteristics of Ti-6Al-4V were obtained from two forgings and compared to reference data in the literature. Both the test data and the reference data were from forgings identified as being in the beta-quenched condition but the fatigue-crack-growth rates were different. This project provided an understanding of the cause of the difference of examining the microstructure and developing additional fatigue crack growth rate (FCGR) data for the six-inch-thick forgings used to develop the test data. The reference data was developed on two-inch-thick forgings.

45453 (AGA–9015609) **Crack growth behavior and modeling: Topical report to Line Pipe Research Supervisory Committee of the Pipline Research Committee of the American Gas Association.** Christman, T.K.; Brust, F.W. American Gas Association, Inc., Arlington, VA (USA); Battelle Columbus Labs., OH (USA). c Mar 1989. 73p. Sponsored by Battelle Columbus Laboratories. (NG–18-179). Available from American Gas Assoication, 1515 Wilson Blvd., Arlington, VA 22209 $50.00.

This report contains data on the investigation into the crack growth of stress-corrosion cracks. The specific subtasks examined were stress-corrosion-crack shapes, identification of a crack driving force parameter, and the relationship between crack shape and mechanical properties. Crack shape data (length and depth) was obtained from five operating pipelines. The individual cracks were found to have length-to-depth ratios ranging from 4 to 8. Longer aspect ratios up to 15 resulted when crack coalescence occurred. The deepest multiple cracks were generally no deeper than the deepest individual cracks indicating that crack coalescence does not greatly affect radial growth. The crack driving force parameter examined stress intensity, K, J-integral, crack tip opening angle (CTOD), and plastic zone size for comparison with the SCC growth characteristics. To conduct the analysis, a three-dimensional finite-element model of the stress-strain field around a part-through surface flaw in line pipe was developed. 10 refs., 22 figs., 7 tabs.

45454 (CANMET–4-9056) **Evaluation of heat affected zone and weld metal toughness in selected steels, phase 1, vol. 1. Final report.** Bala, S.R.; Santyr, S. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). 1986. 359p. (MICROLOG–87-00599). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The effect of heat input and postweld heat treatment on the toughness of coarse grain (CG) heat affected zone (HAZ) has been assessed in two steels, Algoma LT60 (Nb-V) and A710 Gr. A Cl. 3 (Cu-Ni-Nb). The study employed full penetration welds in K-joints as well as Gleeble simulated HAZ. THe CG HAZ toughness of these steels has been compared with that of the Ti-bearing Kawasaki MACS steel claimed to give good toughness at high heat input levels. In LT60 and A710 steels, the amount of CG HAZ present above 20% showed a dominating effect on the crack tip opening displacement (CTOD) toughness, i.e., there was little change in the CTOD toughness with increase in CG above about 20% CG HAZ. The 40 J and the 0.2mm CTOD value transition temperatures of less than -50°C for MACS steel and less than -30°C for both the LT60 and A710 steels have been observed. These suggest that under certain combinations of heat input and heat treatment, the CG HAZ in all the three steels can meet the anticipated specification requirements of Canadian offshore and Arctic structural applications down to -30°C and only the CG HAZ in MACS steels can marginally meet this requirement down to -50°C. 65 refs., 220 figs., 49 tabs.

45455 (CONF-890426–28) **Shallow junction formation in As-implanted Si by low-temperature rapid thermal annealing.** El-Ghor, M.K.; Pennycook, S.J.; Zuhr, R.A. Oak Ridge National Lab., TN (USA). Aug 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; 24-28 Apr 1989. Order Number DE89015970/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Shallow junctions were formed in single-crystal Si(100) by implantation of As at energies between 2 and 17.5 keV followed by conventional furnace annealing or by rapid thermal annealing (RTA). Cross-sectional transmission electron microscopy (XTEM) showed that defect-free shallow junctions could be formed at temperatures as low as 700°C by RTA, with about 60% dopant activation. From a comparison of short-time and long-time annealing, it is proposed

that surface image forces are responsible for the efficient removal of end-of-range (EOR) dislocation loops. 25 refs., 5 figs., 1 tab.

45456 (CONF-890579–1) **Ion beam annealing of Ga-implanted Si.** Withrow, S.P.; Holland, O.W.; Pennycook, S.J. Oak Ridge National Lab., TN (USA). [1989]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From European Materials Research Society spring meeting; 30 May - 2 jun 1989. Order Number DE89016857/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Rutherford backscattering/ion channeling and transmission electron microscopy have been used to investigate regrowth effects which occur during high-energy ion bombardment of amorphous silicon layers implanted with 1×10^{16} Ga/cm^2. At both 300 and 400°C the Si lattice initially regrows epitaxially. However, at this high dopant level, Ga is segregated at the crystalline-amorphous interface and eventually disrupts epitaxy. Transmission electron microscopy had been used to characterize the lattice morphology and monitor movement of the Ga. The results are compared with thermal annealing effects in Ga-implanted Si samples. 15 refs., 4 figs.

45457 (CONF-8811253–1) **The quantitative analysis of fracture surfaces using fractals.** Alexander, D.J. Oak Ridge National Lab., TN (USA). 1988. 26p. Sponsored by Nuclear Regulatory Commission. DOE Contract AC05-84OR21400. From ASTM symposium on evaluation and techniques in fractography; 10 Nov 1988. Order Number DE89015361/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The concept of fractals was used to analyze fracture surface profiles to determine whether fracture surfaces are fractal in nature, and whether the fractal character can be related to either the mechanical properties or the microstructure of the specimens. Sections taken through the fracture surface of fracture toughness specimens were metallographically prepared and photographed, and the fracture profiles were digitized. Simple computer programs which used different techniques to measure the length of the fracture profiles with differing degrees of precision were used to analyze the profiles by generating a fractal plot of apparent profile length versus the measurement step size. The accuracy of the computer programs was verified by examining artificially generated profiles which had a known fractal character. The analyses indicated that fracture surface profiles are indeed fractal, at least over a limited range of detail. However, it was not possible to match the fractal dimension of the fracture profiles to either the mechanical properties of the metals, or to their microstructures. In addition, different profiles taken from the same specimen had different fractal dimensions. Discontinuities in the fractal plot could not be related to the microstructural features. Therefore, although fracture surface profiles are fractal in nature, it appears that this information is not useful in understanding the relationship between the microstructure and the mechanical properties. 18 refs., 8 figs.

45458 (CONF-8903103–2) **Neutron scattering studies of amorphous Invar alloys.** Fernandez-Baca, J.A. Oak Ridge National Lab., TN (USA). 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International symposium on magnetoelasticity and electronic structure of transition metals, alloys, and films; 20-22 Mar 1989. Order Number DE89016868/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper reviews recent inelastic neutron scattering experiments performed to study the spin dynamics of two amorphous Invar systems: $Fe_{100-x}B_x$ and $Fe_{90-x}Ni_xZr_{10}$. As in crystalline Invar $Fe_{65}Ni_{35}$ and Fe_3Pt, the excitation of conventional long-wavelength spin waves in these amorphous systems cannot account for the relatively rapid change of their magnetization with temperature. These results are discussed in terms of additional low-lying excitations which apparently have a density of states similar to the spin waves.

45459 (CU/FE–87-04003) **Stress intensity factors for weld toe cracks in welded T plate joints.** Bell, R. Carleton Univ., Ottawa, ON (Canada). Faculty of Engineering. [1989]. 37p. (MICROLOG–87-04003). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

The Canadian Offshore Steels Research program has concentrated on experimental fatigue investigations of welded plate and tubular joints and on the application of fracture mechanics procedures to the understanding of the fatigue crack propagation behaviour at the weld toe. To supplement this experimental program a linear elastic fracture mechanics (LEFM) fatigue life prediction model has been developed. This report describes the development of the stress intensity factor (SIF) relationships which were incorporated in the AVOCE life prediction model. From the Canadian experimental program results it can be seen that the life of welded T plate joints is dominated by fatigue crack propagation and this accounts for about 70% of the life. After making various assumptions on initial crack size and shape it is possible to describe the growth rate of a crack at the weld toe using a linear elastic fracture mechanics approach in which the growth rate of the crack can be described by a single parameter, the stress intensity factor K. In this report, results for K obtained using 2-dimensional finite elements have been presented for a range of weld toe crcks with crack depth ratios between 0.005 and 0.7 for weld profiles of 30, 45, and 70 degrees. Empirical relationships were fitted to the 2-dimensional results. These equations agree with the finite element results to within 2 - 3 %, depending on the crack depth. Stress intensity factor results are reported for a series of semi-elliptical crack shapes for cracks at the weld toe of T plate joints. Bi-cubic expressions were fitted to the finite element results and the agreement with the original finite element results is very good. 15 refs., 11 figs., 21 tabs.

45460 (DOE/ER/45310–19) **Progress report on grain boundaries.** Balluffi, R.W.; Bristowe, P.D. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Materials Science and Engineering. Jun 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER45310. Order Number DE89015541/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The research was focused on the following three major areas: (1) study of the atomic structure of grain boundaries by means of x-ray diffraction, transmission electron microscopy and computer modeling; (2) study of grain boundary phase transitions by electron microscopy and computer modeling; (3) investigation of the mechanism of high angle grain boundary migration. Results are briefly discussed. 20 refs.

45461 (DOE/ID/12545–1-Vol.1) **Thin section casting program: Volume 1, Executive summary and overview: Final report.** USX Corp., Monroeville, PA (USA). USS Technical Center; Bethlehem Steel Corp., PA (USA). Homer Research Lab. Jan 1989. 45p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-84ID12545. Order Number DE89009030/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The objective of this project which started in September 1984 was to develop a new casting technology which could be both applied to the total range of hot- and cold-rolled sheet steels, and be successfully developed within a five-year project time scale. These requirements resulted in the choice of a thin-section-casting approach (casting around 1-inch-thick) over the alternative strip casting approach (casting around 0.1-inch-thick). The TSC approach was expected to result in significant capital cost, operating cost, and energy savings over current 10-inch-thick slab casting technology.

45462 (DOE/ID/12545–1-Vol.2) **Thin section casting program: Volume 2, Horizontal TSC [thin-section casting] approach: Final report.** USX Corp., Monroeville, PA (USA). USS Technical Center; Bethlehem Steel Corp., PA (USA). Homer Research Lab. Jan 1989. 484p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-84ID12545. Order Number DE89009031/JAW. Available from NTIS, PC A21/MF A01 - OSTI.

In horizontal thin-section casting (HTSC), 1-inch-thick steel sections are produced at speeds up to 600 ipm or about 60 tons per hour per foot of width (tphf). Liquid steel is fed from the ladle, and flows through a specially designed tundish, then flows through a refractory feeding tube, nozzle, with approximately the same external dimensions as the cast section, into a near-horizontal rectangular mold whose all four sides are traveling in the same direction and speed as the steel casting. This report is the second of a six volume set on thin section casting. This volume covers the research on horizontal TSC. 5 refs.

45463 (DOE/ID/12545–1-Vol.2A) **Thin section casting program: Volume 2-A, Appendix to Volume 2: Final report.** USX Corp., Monroeville, PA (USA). USS Technical Center; Bethlehem Steel Corp., PA (USA). Homer Research Lab. Jan 1989. 788p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-84ID12545. Order Number DE89009032/JAW. Available from NTIS, PC A99/MF A01 - OSTI.

This volume contains reports on the design, construction, and operation of the horizontal thin-section-casting dynamic simulator facility (H-DS) at the USS Technical Center's pilot facilities in Universal Pennsylvania (UPF). A dynamic simulator is a small-scale pilot facility that bridges the development gap between bench-scale work and a full-scale pilot facility. The main objectives of the H-DS program are (a) to provide a critical "proof-of-concept" of closed-pool (injection) feeding, and (b) an evaluation of a near-full-scale casting system for steel (1-inch-thick by 17-inch-wide product) using a twin-belt caster. As originally configured, this phase also included a vertical feeding dynamic simulator to be operated concurrently with the H-DS. Based on the DS results, large-scale pilot facilities were to be constructed using the most successful of two feeding approaches for final evaluation. This plan was later modified by only building an H-DS facility at UPF. A smaller version of the V-DS called the V-rig was built at Bethlehem. Expanded casting campaigns are to be conducted independently on each casting approach at UPF and Bethlehem's Research Laboratory. 14 refs.

45464 (DOE/ID/12545–1-Vol.3) **Thin section casting program: Volume 3, Vertical TSC [thin-section casting] approach: Final report.** USX Corp., Monroeville, PA (USA). USS Technical Center; Bethlehem Steel Corp., PA (USA). Homer Research Lab. Jan 1989. 301p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-84ID12545. Order Number DE89009033/JAW. Available from NTIS, PC A14/MF A01 - OSTI.

A prototype vertical twin belt caster was designed, constructed and tested at Bethlehem Steel Corporation's Homer Research Laboratory for the development of a thin section casting process. In the prototype caster the moving mold was aligned vertically and each of the two endless steel belts was tensioned around an upper and a lower large pulley by means of a third smaller pulley. The mold consisted of a long parallel lower section and a shorter V-shaped top section into which liquid steel was fed from a tundish via a submerged refractory nozzle. Mold length, defined as the distance from the meniscus in the V-mouth to the tangent point of the lower pulleys, was about eleven feet. The length of the V-mouth was 27 in. The belts were continuously supported between the upper and lower pulleys by a unique back-up system. Downstream support consisted of two pairs of foot rolls and a vertical water-cooled steel structure that would permit a cast length of about nineteen feet. A chain driven bar was used to start a cast and support the slab. The aim was to cast 1 in. x 17 in. sections at 250 in./min. The details of the prototype vertical caster, except the end walls, are given. The water modeling studies conducted at USSteel to establish tundish nozzle port sizes, inclinations and depth of submergence below the meniscus for optimum flow pattern in the V-mouth are included. The design analyses of the copper end walls and the 10-ton liquid steel trials conducted with the refractory end walls are presented. The fourteen liquid steel trials conducted with the vertical caster and the concluding remarks on vertical feeding system development are discussed.

45465 (DOE/ID/12545–1-Vol.4) **Thin section casting program: Volume 4, Static cast product bending, straightening, and rolling: Final report.** USX Corp., Monroeville, PA (USA). USS Technical Center; Bethlehem Steel Corp., PA (USA). Homer Research Lab. Jan 1989. 63p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-84ID12545. Order Number DE89009034/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Statically cast 1/2", 3/4", and 1" thick steel slabs were subjected to hot rolling in a laboratory reversing mill and to simulated coiling-uncoiling on a three-point bender-unbender. Tensile properties and microstructures of hot bands thinner than 0.15" produced from the statically cast slabs were found to be independent of initial slab thickness and similar to those from conventionally cast 8"-10" thick slabs. Cold rolled and batch annealed product from the statically cast slabs had mechanical properties equivalent to those of conventionally processed deep-drawing quality steel. Overall, the results of this task indicated that 1/2"-1" thick steel sections produced in a twin belt caster can be coiled and uncoiled in a hot coiler box downstream of the caster without generating any cracks in the product, and that the total range of hot and cold rolled sheet and strip products with qualities equivalent to those of conventionally produced can be obtained from the 1/2"-1" thick sections. This report is the fifth of a six volume set on thin section casting.

45466 (DOE/ID/12545–1-Vol.5) **Thin section casting program: Volume 5, Westinghouse MHD Project: Final report.** USX Corp., Monroeville, PA (USA). USS Technical Center; Bethlehem Steel Corp., PA (USA). Homer Research Lab. Jan 1989. 303p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract FC07-84ID12545. Order Number DE89009035/JAW. Available from NTIS, PC A14/MF A01 - OSTI.

This final report includes the subcontract title "Magnetofluidynamically enhanced feeding system for thin section steel caster.".

In September of 1984, the R&D Center entered into a 3-year contract to develop a magnetofluidynamically enhanced feeding system. This report describes the work conducted under this contract. A design for an MFD device to enhance the feeding system of a horizontal steel caster was conceived, analyzed, and successfully tested with a low melting point liquid metal. Difficulties with integrating the device into an existing demonstration caster led to a decision to forego MFD feeding enhancement. All work on the DOE contract was stopped in 1987 upon commercial demonstration of a vertical thin section steel caster. 27 refs., 89 figs., 20 tabs.

45467 (DOE/NE/37963–10) **Deformation induced microstructural and microchemical changes during thermomechanical treatment: Quarterly progress report, October 1, 1988 through December 31, 1988.** Atteridge, D.G.; Bruemmer, S.M.; Murr, L.E.; Wood, W.E. Oregon Graduate Center, Beaverton, OR (USA). 1988. 27p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-86NE37963. Order Number DE89017266/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Considerable activity has been focused in recent years on the structure and behavior of grain boundaries. Most of this activity has centered on atomistic aspects and has not enabled direct interpolation of results toward mechanical properties in engineering materials. As a result, significant developments in basic understanding of grain boundary structure have not significantly impacted engineering practice. Topics covered in this report are: thermomechanical effects on grain boundary microstructure, thermomechanical effects on grain boundary microchemistry, processing and fabrication characterizing, and integration and modeling. 7 figs., 2 tabs.

45468 (DOE/NE/37963–11) **Deformation induced microstructural and microchemical changes during thermomechanical treatment: Quarterly progress report, January 1, 1989 through March 31, 1989.** Atteridge, D.G.; Bruemmer, S.M.; Murr, L.E.; Wood, W.E. Oregon Graduate Center, Beaverton, OR (USA). [1989]. 37p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-86NE37963. Order Number DE89017267/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Considerable activity has been focused in recent years on the structure and behavior of grain boundaries. Most of this activity has centered on atomistic aspects and has not enabled direct interpolation of results toward mechanical properties in engineering materials. As a result, significant developments in basic understanding of grain boundary structure have not significantly impacted engineering practice. Thus the impetus for this study. Topics covered in this report are: thermomechanical effects on grain boundary microstructure, thermomechanical effects on grain boundary microchemistry, processing and fabrication characterizing, and integration and modeling. 10 refs., 16 figs., 2 tabs.

45469 (IC–89/64) **Mechanics of iron, its stability and phase transformation.** Thakur, K.P.; Thakur, O.P. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 33p. Order Number DE89636210/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The comprehensive investigation of the mechanics of iron subjected to arbitrary fluid pressure has been carried out. Apart from

the classical elastic moduli (k, M, and M') and conventional elastic moduli (Green and stretch moduli) computations are carried out for the family of generalised moduli of which the conventional moduli are just the specific members. With the generalized moduli the mechanical stability of iron is investigated through Born criteria. It is found that classical stability, Green stability and stretch stability are all represented uniquely by the present generalised scheme. The definition of effective classical moduli under stresses enabled the amalgamation of the Born criteria of lattice stability into the single classical criteria of lattice stability of cubic crystal under hydrostatic loading environment. Computations are also carried out to investigate the coordinate and stress dependence of Young's modulus of elasticity, Poisson's ratio, mean velocity of elastic wave, and Debye temperature. Surprisingly, it is found that all these properties of solids play an important role in representing the mechanical stability of the solid. The path of uniaxial loading of iron is also investigated along with its internal energy variation on this path. This indicated the existence of stress-free fcc phase of iron on the path of uniaxial deformation at cell length a = 3.6444 A giving enthalpy of transformation (bcc -> fcc) of 1.1 kJ/mol in good agreement with experimental results. (author). 16 refs, 10 figs, 2 tabs.

45470 (IC–89/77) **Electron theory of long wavelength concentration fluctuations in liquid metal alloys.** Wang Li; Tosi, M.P. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 8p. Order Number DE89636213/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Long-wavelength concentration fluctuations in a binary liquid metal alloy are determined by a pair interchange free energy w, which is exactly given by the sum of an elastic strain term and of the concentration-concentration direct correlation function. The latter is evaluated in an alloy of homovalent components by electron screening theory in the pseudopotential approach of Shaw and Harrison and shown to be entirely determined by non-local terms reflecting charge transfer to the more electronegative alloy component. Numerical calculations for the liquid Na-K alloy show strong cancellation between the two contributions to w at all concentrations, in qualitative agreement with experiment. (author). 15 refs, 1 tab.

45471 (INIS-BR–1600) **Study of electric resistivity in function of temperature in Ni_2Mn (Sn_{1-x} In_x) type Heuster alloys.** Fraga, G.L.F. Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Inst. de Fisica. 1984. 161p. (In Portuguese). Order Number DE89636214/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The electric resistivity as a function of temperature and concentration was measured in the range 4.2 <= T <= 300 K, for the pseudo-ternary Heusler alloys Ni_2Mn (Sn_{1-x} In_x), with x = 0; 0.02; 0.05; 0.10; 0.15; 0.85; 0.90; 0.95; 0.98 and 1.00. In the lower temperature region (7 <= T <= 20 K) all the alloys followed an aT^n - law. The 0 <= x <= 0.15 alloys have shown two different temperature behavior: from 7 to 12 K the obtained n-value was about 5, in accordance with a Bloch-Grueneisen electron-phonon process; between 12 and 20 K the observed n-value was about 3.4, probability due to the presence of magnetic scattering mechanism. This last mechanism probably prevailed in the 0.85 <= x <= 1.00 alloys with presented an n-value of about 2.4 in the temperature range of 7 to 20 K. In the higher temperature region (150 <= T <= 300 K) all the alloys followed an $AT + BT^2$ function; the linear term is mostly ascribed to electron-phonon scattering process and the quadratic one to magnetic scattering mechanism. For the ternary alloys Ni_2MnSn and Ni_2MnIn the experimental magnetic term BT^2 is well fitted by the Kasuya's magnetic spin-disorder model. (author).

45472 (INIS-BR–1609) **Study of creep in stainless steel irradiated with fast neutron and alpha particles.** Correa, D.A.C.; Tese (M.Sc.). Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1985. 133p. (In Portuguese). Order Number DE89636222/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The objective of the present work is to study the creep behavior of the 316 type stainless steel 50% cold worked in different conditions of temperature and applied stress, after neutron radiation and Alfa particles implantation. For this experiment, non-irradiated samples, samples irradiated in the research reactor IEA-R1 with fast neutron (E≥ MeV) up to a fluence of $8.6.10^{17}$ n/cm^2, and samples implanted with Alfa particles in the cyclotron CV-28 with Helium concentrations of 5 and 26 appm, were creep tested with applied stresses of the 200-300 MPa at temperatures between 650^{0}C and 700^{0}C. The deformation versus time curves were plotted and it was observed tha the second stage is not well defined, with the creep rate increasing continuously until the occurrence of failure of the material. The study of the effect of increase from 200 MPa to 300 MPa at the same temperature was performed. It can be concluded that this increase produces an approximately 70% reductions in the fracture time of the material, with practically no influence in the total deformation. Samples were tested at different temperatures (650, 675 and 700^{0}C) at a same applied stress (200 MPa). It has been observed that a temperature of 50^{0}C produces 98,9% of reduction in the fracture time and almost doubles the total deformation. On neutron irradiated samples, creep tests were performed at the same temperature and stress of the non irradiated samples. Comparing the results obtained a tendency of embrittlement due to the neutron irradiation can be observed; no remarkable structure changes were detected due to small fast neutron. Microstructural and metalographic observations were performed before and after each creep test. (author).

45473 (INIS-mf–11952) **The role of damage analysis in the assessment of service-exposed components.** Bendick, W.; Muesch, H.; Weber, H. Verein Deutscher Eisenhuettenleute (VDEh), Duesseldorf (Germany, F.R.). 1987. 20p. (CONF-8711319–: 10. lecture meeting on long-term behaviour of heat-resistant steels and high-temperature materials, 27 Nov 1987). Order Number DE89910835/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Components in power stations are subjected to service conditions under which creep processes take place limiting the component's lifetime by material exhaustion. To ensure a safe and economic plant operation it is necessary to get information about the exhaustion grade of single components as well as of the whole plant. A comprehensive lifetime assessment requests the complete knowledge of the service parameters, the component's deformtion behavior, and the change in material properties caused by longtime exposure to high service temperatures. A basis of evaluation is given by: (1) determination of material exhaustion by calculation, (2) investigation of the material properties, and (3) damage analysis. The purpose of this report is to show the role which damage analysis can play in the assessment of service-exposed components. As an example the test results of a damaged pipe bend will be discussed. (orig./MM).

45474 (INIS-SU–89, pp. 175-176) **Synthesis and physicochemical properties of semiconductor materials of A^1-B^5-C^6 (A^1-Li, Rb, Cs; B^5-Sb, B; C^6-S, Se, Te) system and prospects for their use in microelectronics.** Bazakuda, V.A. (Khar'kovskij Politekhnicheskij Inst., Kharkov (Ukrainian SSR)); Gnidash, N.I.; Pod"yachaya, E.N.; Ryabchun, A.A.; Salon, A.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.

Short Communication

45475 (INIS-SU–111/A, pp. 52-53) **Twinning in CdTe (111) films on GaAs (100) substrates.** Karasev, V.Yu. (AN SSSR, Moscow (USSR). Inst. Kristallografii); Kiselev, N.A.; Dvoretskij, S.A.; Gutakovskij, A.K.; Sabinina, I.V.; Sidorov, Yu.G. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Available from NTIS (US Sales Only), PC A08/MF A01; INIS.

'Short Communication.'

45476 (INIS-SU–111/A, pp. 50-51) **Homogeneity of properties of InAs films produced by molecular beam epitaxy on GaAs (100).** Kalagin, A.K. (AN SSSR, Novosibirsk (USSR). Inst. Fiziki Poluprovodnikov); Moshegov, N.T.; Olzoev, I.K.; Tikhomirov, V.V.; Toropov, A.I. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal

growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

45477 (INIS-SU–111/A, pp. 112-113) **Growth of nonequilibrium singular faces of tantalum monocrystals at autoepitaxy.** Golubev, O.L. (AN SSSR, Leningrad (USSR). Fiziko-Tekhnicheskij Inst.). AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
'Short Communication.'

45478 (INIS-SU–111/A, pp. 145-146) **Temperature dependence of (100) GaAs and InAs surface structure transitions.** Preobrazhenskij, V.V. (AN SSSR, Novosibirsk (USSR). Inst. Fiziki Poluprovodnikov); Lubyshev, D.I.; Migal', V.P. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

45479 (IPEN-PUB–244) **Work hardening, recovery and recrystallization of alloys containing dispersed precipitates.** Padilha, A.F. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Dept. de Metalurgia Nuclear. Jan 1989. 34p. (In Portuguese). Order Number DE89636211/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.
This paper reviews the work hardening, recovery and recrystallization mechanisms in alloys containing dispersed precipitates. In the section on work hardening, the influence od spacing, particle size and shape on the density and distribution of dislocations have been discussed. They represent a large part of the energy stored in the material following drformation, which in turn is driving force for recrystallization. Next, the role of precipitates on recovery, on the formation and the growth of recrystallized regions has been discussed in detail. The competition between recovery and recrystallization and recrystallization of supersaturated solid solutions have also been mentioned. Finally, the technological relevance of the aspects treated in this paper has been discussed. (author).

45480 (KAPL–4701) **Corrosion rates of structural materials on the ocean floor.** Barth, C.H.; Sheldon, R.B. Knolls Atomic Power Lab., Schenectady, NY (USA). Apr 1989. 33p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC02-76ET34202;AC12-76SN00052. Order Number DE89015211/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.
Corrosion experiments were conducted to provide insight into the nature of corrosion on the deep ocean floor. Corrosion rates were determined for carbon steel, low alloy steel, carbon steel in contact with stainless steel, Ni-Cr-Fe alloy 600, and various stainless steels in deep ocean environments. Specimens for corrosion studies were deployed mostly by submersible at depths between 3000 and 3700 meters for exposure periods of up to seven years. Experimental conditions for determining corrosion behavior were flowing, stagnant, and semi-stagnant seawater. Specimens were also completely buried in sediment and buried in sediment with the addition of a steel cover plate to blanket the sediment surface. Mean long term rates as shown in the following graph ranged from .03 to 2.75 mils per year for carbon steel (CS-516) and low alloy steel (HY-80) and up to 8.49 mils per year for carbon steel in contact with stainless steel (galvanic effect). Specimens buried in the sediment demonstrated the largest variability with individual specimen corrosion rates for carbon steel as great as 6.5 mils per year. When a steel plate covered the sediment the corrosion rate decreased to a relatively constant rate of .15 mils per year. Experiments were conducted in shallow water sites for corrosion rate comparisons with deep water exposures. Shallow water experiments generally produced rates ten times higher for specimens submerged in the sediment and thirty percent higher in flowing environments. Several Atlantic and Pacific Ocean sites were also used for comparison studies and results showed moderate differences. 9 refs., 10 figs., 8 tabs.

45481 (KCP–613-4080) **High-speed machining of aluminum: Final report.** Heine, S.J. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1989. 64p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. Order Number DE89014011/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.
High-speed machining of aluminum alloys has become an established manufacturing process for a variety of production parts at Allied- Signal Inc., Kansas City Division. Some of these parts include a Mounting Deck, a Forward Retainer, and a Mount. In the course of developing the production machining processes for these parts, general tooling and machining parameters were developed that aid in the application of this technology to future parts. High-speed machining is a cost effective, viable manufacturing process for aluminum material when correct part selection criteria and processing parameters are applied. 5 refs., 12 figs., 7 tabs.

45482 (KCP–613-4082) **Cutting fluid performance testing: Tapping torque test.** Kelley, E.E. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1989. 26p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. Order Number DE89014013/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.
A tapping torque test was conducted on 10 cutting and tapping fluid samples. The test was performed to establish the comparative efficacy of competitive fluids in controlled conditions. The recent health concern over trichloroethane in tapping fluids has prompted this test series which rated the performance of these solvent-based tapping fluids against possible replacement fluids free of this hazardous material. A nontrichloroethane-based tapping fluid replacement for hand-tapping titanium was identified in this study. The replacement, though more expensive than the solvent-based tapping fluid, resulted in nearly a 50-percent decrease in hand-tapping costs because of a five-fold increase in tap life. 2 refs., 1 tab.

45483 (KFK–4561) **Investigations on the hardening, tempering and transformation behaviour and on the mechanical properties of the martensitic steel DIN 1.4914. NET-heat MANET-1.** Schirra, M.; Heger, S.; Meinzer, H.; Ritter, B.; Schweiger, W. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion. Jun 1989. 64p. (In German). Order Number DE89915150/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.
In the frame of the NET-activities (Next European Torus) the martensitic steel X18CrMoVNb12.1 (DIN 1.4914) was considered as an alternative to the austenitic stainless steel AISI 316L as first-wall- and blanket structural material. Most recently these work has been transfered for the long-term DEMO-oriented part of the fusion technology program. The KfK-IMF II has specified a NET-heat, named MANET-1, which was produced by SAARSTAHL-GmbH, used for various investigation programs of the partner in the NET-team. The report describes the investigations to characterize this material done by KfK-IMF II. As result of hardening and tempering treatments a reference treatment was determined. The transformation behaviour can be described by a continuous time-temperature-transformation diagram (TTT). The tensile strength was determined in dependence of the tempering and test temperature. The impact strength is presented as a Av-t-curve for longitudinal and transversal ISO-V specimens. The creep and creep-rupture tests in the temperature range of 500 to 650^{0}C have been performed for three heat-treatment conditions. Metallographic examinations show the fracture behaviour. The test results of the MANET-1 heat are compared with the results of other variants of this steel type in the Fast-Breeder-Program. (orig.).

45484 (LA-UR–89-2459) **Strain and particle size of palladium powders by time-of-flight neutron diffraction.** Lawson, A.C.; Conant, J.W.; Talcott, C.L.; David, M.A.; Vaninetti, J.; Goldstone, J.A.; Williams, A.; Von Dreele, R.B.; Roof, R.B.; Hitterman, R.L.; Richardson, J.W. Jr.; Faber, J. Jr. Los Alamos National Lab., NM (USA). [1989]. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8907126–1: 38. annual x-ray

conference, 31 Jul - 4 aug 1989). Order Number DE89015304/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have determined the strain and particle size for several samples of palladium powder by time-of-flight neutron powder diffraction on two different diffractometers and by x-ray powder diffraction. The results are compared and found to be in fair agreement. The time-of-flight method gives good enough precision to reveal deficiencies in the simple models used for strain and particle size line broadening. 6 refs., 4 figs., 2 tabs.

45485 (LA-UR–89-2701) **Microstructural effects on spall fracture in 1008 steel.** Zurek, A.K.; Follansbee, P.S. Los Alamos National Lab., NM (USA). [1989]. 5p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-890812–39: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016770/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The brittle fracture behavior of 1008 carbon steel was characterized under dynamic spall loading conditions. The role of grain size, carbide morphology, and high strain rate plastic deformation on the spall induced cleavage fracture were quantitatively estimated following the analysis of Lin, Evans, and Ritchie. 7 refs., 2 figs., 14 tabs.

45486 (LA-UR–89-2818) **Acceleration of metal plates.** Marsh, S.P.; McQueen, R.G.; Tan, T.H. Los Alamos National Lab., NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–36: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016816/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

High-explosive charges have been used to accelerate stainless steel plates to velocities of 6-7 km/s. A two-stage system has been used in which the first stage is a plane-wave detonating system that accelerates the plate down a short barrel. The second stage consists of a hollow cylindrical charge through which the moving plate passes. After an adjustable delay this charge is detonated on the outer circumference of the entry side of the charge. Flash radiographs and witness plates show no breakup in the first stage but bowing and frequent breakup in the second stage. 6 figs.

45487 (LA-UR–89-2967) **Temperature effects in shock consolidation of metal powders.** Staudhammer, K.P. Los Alamos National Lab., NM (USA). [1989]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–34: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016782/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The understanding of residual microstructure and properties of shock consolidated metal powders, knowledge of specific temperature effects pertinent to and resulting from shock events are important parameters. These temperature parameters can be described as the ambient, adiabatic, residual, and strain temperatures. To know these temperatures would be extremely desirable, particularly their sources, magnitudes and method or degree of control so as to optimize the consolidation process. In this work, temperature effects are obtained under conditions which investigates each variable relative to the overall temperature time history. 5 refs., 5 figs.

45488 (LBL–26935) **Micromechanisms of surface friction in zinc electrogalvanized steel sheets.** Shaffer, S.J.; Philip, A.M.; Morris, J.W. Jr. Lawrence Berkeley Lab., CA (USA). 4 Apr 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8909114–: Galvatech '89 conference, 5-7 Sep 1989). Order Number DE89011819/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Significant variations are found in the measured coefficients of friction of commercial zinc electrogalvanized steel (EGS) sheets. The tribological mechanisms apparently differ from those in bare steel. Because of the relative softness of the zinc layer its mechanical properties are important in determining the coefficient of friction. Since zinc is hexagonal its mechanical properties are highly anisotropic, which suggests that the coefficient of friction should depend strongly on the crystallographic texture of the galvanized layer. Such a dependence was found in draw-bead simulator tests on a variety of commercial steels; coatings with a strong basal texture had particularly high coefficients of friction. This result is interpreted on the basis of a simple model that considers the interaction between asperities on the rigid tool and the relatively deformable coating. 12 refs., 9 figs., 1 tab.

45489 (LBL–27356) **Methods to decrease defect density in GaAs/Si heteroepitaxy.** Liliental-Weber, Z. Lawrence Berkeley Lab., CA (USA). Jun 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890426–26: Spring meeting of the Materials Research Society, 24-28 Apr 1989). Order Number DE89016306/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In this paper, the fundamental mechanisms of procedures improving the structural quality of GaAs grown on Si are discussed. Patterned growth, strained layer superlattices and power thermal cycling are promising approaches to achieve a high quality of GaAs layers grown on Si substrates. 48 refs., 8 figs.

45490 (LBL–27498) **Characterization of GaAs/Si/GaAs heterointerfaces.** Liliental-Weber, Z.; Mariella, R.P. Jr. Lawrence Berkeley Lab., CA (USA). Jun 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890426–25: Spring meeting of the Materials Research Society, 24-28 Apr 1989). Order Number DE89016302/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Transmission electron microscopy of GaAs grown on Si for metal-semiconductor-metal photodetectors is presented in this paper. Two kinds of samples are compared: GaAs grown on a 15 Å Si epilayer grown on GaAs, and GaAs grown at low temperature (300°C) on Si substrates. It is shown that the GaAs epitaxial layer grown on thin Si layer has reverse polarity to the substrate (antiphase relation). Higher defect density is observed for GaAs grown on Si substrate. This higher defect density correlates with an increased device speed, but with reduced sensitivity. 8 refs., 9 figs.

45491 (NUREG/CR–5388) **Steel impurity element effects on postirradiation properties recovery by annealing: Final report.** Hawthorne, J.R. Nuclear Regulatory Commission, Washington, DC (USA). Div. of Engineering; Materials Engineering Associates, Inc., Lanham, MD (USA). Aug 1989. 170p. Sponsored by Nuclear Regulatory Commission. (MEA–2354). Available from NTIS, PC A09/MF A01 - GPO - OSTI.

The influence of copper content and phosphorus content on notch ductility recovery by 399°C postirradiation heat treatment was explored for A 533-B and A 302-B pressure vessel steels. Charpy-V (C_v) specimens for the investigation were obtained from ten plates produced from four (4-way split) laboratory melts. The plates were heat treated to reproduce the microstructure of 150-mm and thicker A 302-B plates at the quarter-thickness location. Specimens were irradiated at 288°C (550°F) to a fluence of $\sim 2.5 \times 10^{19}$ n/cm^2 in the UBR test reactor. Other specimens were thermally conditioned at 288°C and at 288°C followed by 399°C to benchmark the effects of temperature in the absence of irradiation. A 0.30% copper content was found to have a significant influence on the magnitude of residual embrittlement after a 168-hour anneal. In contrast, phosphorus contents in the range of 0.002 to 0.025% were not found to have an effect on notch ductility recovery for either a high or a low copper content. Essentially full recovery in 41-J transition temperature was observed for the high phosphorus, low copper content steel versions. A detrimental influence of a 0.68% nickel content on recovery behavior is shown by the data for the 0.28% copper content plates but not the 0.16% copper content plates. 13 refs., 16 figs., 4 tabs.

45492 (ORNL/FMP–89/1) **Advanced Research and Technology Development Fossil Energy Materials Program: Semiannual progress report for the period ending March 31, 1989.** Judkins, R.R.; Braski, D.N. (comps.). Oak Ridge National Lab., TN (USA). Jul 1989. 637p. Sponsored by U.S. DOE Fossil Energy. DOE Contract AC05-84OR21400. Order Number DE89015665/JAW. Available from NTIS, PC A99/MF A01 - OSTI; GPO Dep.

The objective of the Advanced Research and Technology Development (AR&TD) Fossil Energy Materials Program is to conduct research and development on materials for fossil energy applications with a focus on the longer-term and generic needs of the various fossil fuel technologies. The Program includes research

aimed toward a better understanding of materials behavior in fossil energy environments and the development of new materials capable of substantial enhancement of plant operations and reliability. This combined semiannual progress report of activities on the program is in accordance with a work breakdown structure in which projects are organized according to materials research areas. These areas are (1) Ceramics, (2) Alloy Development and Mechanical Properties, (3) Corrosion and Erosion Research, and (4) Assessments and Technology Transfer. Individual projects are processed separately for the data bases.

45493 (ORNL/FTR–3338) **Discussion on microscopy and microanalytical techniques of alloys and stainless steels, Oxford, Great Britain, July 15–August 4, 1989: Foreign trip report.** Miller, M.K. Oak Ridge National Lab., TN (USA). 21 Aug 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016874/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Fruitful discussions on the aging of primary coolant pipe steels used in nuclear reactors were held during the International Workshop on "Intermediate Temperature Embrittlement Processes in Duplex Stainless Steels." The 36th International Field Emission Symposium (IFES) afforded the opportunity of a comprehensive review of the current atom probe field-ion microscopy research and development in both the technique and applications of all the major atom probe groups. The cooperative research with the University of Oxford atom probe group has produced a new approach for the examination and quantification of atom probe data.

45494 (ORNL/TM–11158) **Simulation of the welding of irradiated materials.** Lin, Hua Tay. Oak Ridge National Lab., TN (USA). Jul 1989. 272p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015656/JAW. Available from NTIS, PC A12/MF A01 - OSTI; GPO Dep.

Helium was uniformly implanted using the "tritium trick" technique to levels of 0.18, 2.5, 27, 105 and 256 atomic part per million (appm) for type 316 stainless steel, and 0.3 and 1 appm for Sandvik HT-9 (12 Cr-1MoVW). Both full penetration as well as partial penetration welds were then produced on control and helium-containing materials using the autogenous gas tungsten arc (GTA) welding process under full constraint conditions. For full penetration welds, both materials were successfully welded when they contained less than 0.3 appm helium. However, welds of both materials, when containing greater than 1 appm helium, were found to develop cracks during cooling of the weld. Transmission and scanning electron microscopy indicated that the HAZ cracking was caused by the growth and coalescence of grain boundary (GB) helium bubbles. This cracking occurred as a result of the combination of high temperatures and high shrinkage tensile stresses. The cracking in the fusion zone was found to result from the precipitation of helium along dendrite interfaces. A model based on the kinetics of diffusive cavity growth is presented to explain the observed results. The model proposes a helium bubble growth mechanism which leads to final intergranular rupture in the heat-affected zone. Results of the present study demonstrate that the use of conventional fusion welding techniques to repair materials degraded by exposure to irradiation environments may be difficult if the irradiation results in the generation of helium equal to or greater than 1 appm.

45495 (PNL–6887) **Freeze-dried processing of tungsten heavy alloys.** White, G.D.; Gurwell, W.E. Pacific Northwest Lab., Richland, WA (USA). Jun 1989. 41p. Sponsored by U.S. Department of Defense. DOE Contract AC06-76RL01830. Order Number DE89015171/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Tungsten heavy alloy powders were produced from freeze-dried aqueous solutions of ammonium metatungstate and, principally, sulfates of Ni and Fe. The freeze-dried salts were calcined and hydrogen reduced to form very fine, homogeneous, low-density, W heavy alloy powders having a coral-like structure with elements of approximately 0.1 μm in diameter. The powders yield high green strength and sinterability. Tungsten heavy alloy powders of 70%, 90%, and 96% W were prepared by freeze drying, compacted, and solid-state (SS) sintered to fully density at temperatures as low as 1200°C and also at conventional liquid-phase (LP) sintering temperatures. Solid-state sintered microstructures contained polygonal W grains with high contiguity; the matrix did not coat and separate the W grains to form low-contiguity, high-ductility structures. Liquid-phase sintered microstructures were very conventional in appearance, having W spheroids of low contiguity. All these materials were found to be brittle. High levels of residual S accompanied by segregation of the S to all the microstructural interfaces are principally responsible for the brittleness; problems with S could be eliminated by using Fe and Ni nitrates rather than the sulfates. 9 refs., 22 figs., 3 tabs.

45496 (PNL-SA–17213) **Grain boundary chemistry in irradiated stainless steel and its influence on environmental degradation.** Bruemmer, S.M.; Simonen, E.P.; Charlot, L.A. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 16p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-890820–3: 4. international symposium on environmental degradation of materials in nuclear power systems: water reactors, 6-10 Aug 1989). Order Number DE89016827/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Radiation-induced segregation (RIS) of chromium, silicon and phosphorus and its influence on intergranular stress corrosion cracking (IGSCC) of stainless steel (SS) has been investigated. Material and irradiation effects on RIS to grain boundaries were studied using ion bombardment of fine-grained, sputter-deposited SS. Damage levels up to 10 dpa were produced in near-surface regions encompassing several grain diameters in depth. The resultant "bulk" damage promotes RIS of silicon and depletion of chromium at grain interfaces. Silicon enrichment and chromium depletion was highly localized to within 25 nm of the boundary in 316 SS heats as measured by analytical transmission electron microscopy. No significant grain boundary enrichment of phosphorus was observed in these heats even though heats contained very high levels of phosphorus in the bulk. Grain boundary chemistry effects on the IG corrosion and SCC of 316 SS have also been examined by varying phosphorus segregation and chromium depletion through controlled thermal treatments. 28 refs., 3 figs.

45497 (SAND–89-0920C) **Experimental measurements of shock-induced vaporization in cadmium and lead.** Asay, J.R.; Trucano, T.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–15: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016877/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Time resolved techniques were used to study the shock-induced vaporization of lead and cadmium for partial states of vaporization ranging from 11-37% in lead and 42-56% in cadmium. The experimental results were compared with numerical simulations of the experiments which indicate that the expansion products are more dispersive than predicted with numerical calculations. The present data suggest that either diffusing flow between vapor and liquid phases or vaporization kinetics are important at these rates. 10 refs., 4 figs., 1 tab.

45498 (SAND–89-0933C) **Time-resolved penetration response of ceramic and steel plates.** Wise, J.L.; Kipp, M.E. Sandia National Labs., Albuquerque, NM (USA). [1989]. 5p. Sponsored by U.S. Department of Defense. DOE Contract AC04-76DP00789. (CONF-890812–10: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016029/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A laser velocity interferometer system (VISAR) has generated records of free-surface particle velocity for target assemblies incorporating alumina, boron carbide, titanium diboride, and steel plates that were subjected to impact loading by small scale, long-rod penetrators fabricated from a tungsten alloy. The measured particle-velocity data have been compared to calculational results obtained with a multidimensional wave-propagation code (CTH). 5 refs., 6 figs., 3 tabs.

45499 (SAND–89-0998C) **Shock-induced atomic-scale structure in metals.** Taylor, P.A.; Dodson, B.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 9p. Sponsored by U.S. DOE

Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–20: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016539/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The first atomic-scale simulations of shock propagation using accurate many-body atomic interactions have been performed. Shock propagation in copper was modeled using the embedded-atom method. Lattice instabilities, consisting of crystallographic twinning boundaries and martensitic regions, were observed to form and propagate behind the shock front for impact velocities as low as 0.01 km/sec. The twinning boundary dislocations cause a loss of shear strength, resulting in a significant reduction in shock wave vleocity without causing permanent crystallographic damage. This new mode of lattice deformation is qualitatively different from the behavior characteristic of pairwise atomic interactions. 8 refs., 2 figs.

45500 (SAND–89-1331) **Development of the steel/aluminum composite gate for the modified auxiliary closure.** Chiu, R.Y. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89015197/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The propulsion working fluid for the containment closure used at the Nevada Test Site consists of a mixture of a driver gas and the hot detonation products from the shaped charge that cuts the wall of the storage vessel. Nitrogen has always been used as the driver gas. However, helium gas, because of its superior propulsion characteristics, has enabled us to design considerably heavier and stronger gates. Operational times can be equal to or less than operational times when nitrogen gas was used. Assume, maintaining the same functional time, that an appreciably stronger steel/aluminum composite gate is designed and developed. The gate consists of two 3/4-in.-thick, high-strength 4340 circular steel plates imbedded in the two sides of the 7075-T73 aluminum forging. Mechanical circular keys are used to ensure the effective transfer of horizontal shear loads from aluminum to steel. Three point bending experiments on small composite beams were conducted to determine the effectiveness of the mechanical keying system. Also explored was structural adhesive used as a bonding and shear transfer mechanism. 4 refs., 8 figs., 1 tab.

45501 (SAND–89-1331C) **Development of the steel/aluminum composite gate for the modified auxiliary closure.** Chiu, R.Y. Sandia National Labs., Albuquerque, NM (USA). [1989]. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909163–1: 5. symposium on containment of underground nuclear explosions, 19-21 Sep 1989). Order Number DE89016417/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The propulsion working fluid for the containment closure used at the Nevada Test Site consists of a mixture of a driver gas and the hot detonation products from the shaped charge that cuts the wall of the storage vessel. Nitrogen had always been used as the driver gas. However, helium gas, because of its superior propulsion characteristics, has enabled us to design considerably heavier and stronger gates. Operational times can be equal to or less than operational times when nitrogen gas was used. Assume, maintaining the same functional time, that an appreciably stronger steel/aluminum composite gate is designed and developed. The gate consists of two 3/4-in.-thick, high-strength 4340 circular steel plates imbedded in the two sides of the 7075-T73 aluminum forging. Mechanical circular keys are used to ensure the effective transfer of horizontal shear loads from aluminum to steel. Three point bending experiments on small composite beams were conducted to determine the effectiveness of the mechanical keying system. Also explored was structural adhesive used as a bonding and shear transfer mechanism. 4 refs., 8 figs., 1 tab.

45502 (SAND–89-8242) **A characterization of the side bonding, upset plug welding process.** Johnson, S.B. Sandia National Labs., Livermore, CA (USA). Aug 1989. 34p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DR00789. Order Number DE89015181/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The goal of this investigation was to characterize the side bonding variant of the upset plug welding process. In this process an oversized plug is driven into an opening where it is welded in place with the heat of electric current. The processing parameters studied in this work were weld current, closing force, weld time, plug fit, and interfacial cleanliness. The results were measured in terms of plug displacement, metallurgical structure, and bond length. The results of the experiments indicate that force has a modest influence on cold plug displacement, but little effect on ultimate bond quality. Plug fit has a moderate influence on cold displacement. Lubricous contamination can affect a sharp increase in cold displacement. With the passage of current, the weld structure is seen to develop quickly, then reach a point of equilibrium and become independent of weld time after that. Higher levels of current bring the process to completion sooner, but given sufficient time the end results can be the same for a wide range of currents. In a quantitative way, this work presents data which facilitates optimal selection of processing parameters. Qualitatively, the information provides insight into the basic mechanisms of the process. On a conceptual level, approaches for controlling quality are presented. Most significantly, the results of the work portray side bonding, upset plug welding as a remarkably robust process, extremely tolerant of major variations in processing parameters. 1 ref., 15 figs.

45503 (UCRL–53934) **The influence of cooling rate on the microstructure of stainless steel alloys.** Elmer, J.W. Lawrence Livermore National Lab., CA (USA). c Sep 1988. 388p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89016714/JAW. Available from NTIS, PC A17/MF A01; OSTI; INIS; GPO Dep.

Thesis. Submitted to Massachusetts Institute of Technology, Cambridge, MA.

The emergence of high energy density welding, laser surface modification and rapid solidification as commonly used metallurgical processing techniques has greatly increased the range of cooling rates that can be accessed during the solidification of metals and alloys. The microstructures which develop during these rapid cooling conditions may be significantly different from those which develop during low cooling rate conditions as the result of access to new metastable phases with the additional kinetic limitations that accompany rapid solidification. This investigation explores the influence of cooling rate on a series of seven ternary alloys which span the line of two-fold saturation in the Fe-Ni-Cr system. High speed electron beam surface melting was used to resolidify these alloys at scan speeds up to 5 m/s. The resulting cooling rates were estimated from dendrite arm spacing measurements and were confirmed by heat flow modeling to vary from 7×10^0 °C/s to 8×10^6 °C/s. The microstructures that developed from each solidification condition were examined using optical metallography, electron microprobe analysis, scanning electron microscopy and a vibrating sample magnetometer. These results were used to create diagrams to predict the primary mode of solidification, the ferrite content and the complex microstructural morphologies which develop as a function of interface velocity and composition. 158 refs., 90 figs., 45 tabs.

45504 (UCRL–101275) **Performance of multilayer coated concave gratings in the extreme ultraviolet.** Bixler, J.V.; Barbee, T.W. Jr.; Dietrich, D.D. Lawrence Livermore National Lab., CA (USA). 13 Jun 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890836–7: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, 6-11 Aug 1989). Order Number DE89016636/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent advances in multilayer structures for the Extreme Ultraviolet now make it possible to construct diffraction gratings in the wavelength range below 250 Å which can be used for precision measurements using normal incidence spectrometers. We report results from two such gratings, one conventionally ruled and other holographically ruled. Both are one meter radius, 1200 lines per millimeter gratings coated with a molybdenum-silicon multilayer for use in the 150 Å wavelength region. A McPherson 225 one meter normal incidence spectrometer with a Garton flash tube source and a film detector was used to test the resolution. Semiquantitative efficiency measurements were made by comparing the spectra with

that produced by an osmium coated gratings. Oxygen lines in the wavelength region of interest (characteristic of the source) are easily detected and well resolved with both multilayer coated gratings. The same lines are faint or undetected with the osmium coated grating. Quantitative efficiency measurement were performed using a Penning source and a photon counting detector. 9 refs., 4 figs., 1 tab.

45505 (UCRL–101547) **Delayed failure of silver-aided diffusion welds between steel.** Kassner, M.E.; Rosen, R.S.; Henshall, G.A.; King, W.E. Lawrence Livermore National Lab., CA (USA). 17 Jul 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8909171–1: 2. international conference on brazing, high-temperature brazing and diffusion welding, 19-20 Sep 1989). Order Number DE89016652/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Silver interlayer diffusion bonds that were fabricated using planar-magnetron sputtering exhibited very high tensile strengths. However, these joints undergo delayed failure at relatively low tensile stresses at ambient temperature, apparently by a microvoid coalescence mechanism at the bond interfaces. Two classes of delayed tensile failure were investigated. In the first case, the applied stress does not produce any plastic deformation in the base metal, and failure appears to be controlled by time-dependent plasticity within the silver interlayer. In the second case, modest time-dependent plasticity is observed in base metals, and concomitant shear occurs within the softer silver under a high triaxial stress state. Here, the time-dependent plasticity of the base metal may accelerate the failure. These findings are believed to be applicable to bonds for which the interlayers are prepared by processes different than physical vapor deposition. 15 refs., 6 figs.

45506 (WIC–7-184-071-099) **Evaluation of heat affected zone and weld metal toughness in selected steels, phase 1, vol. 2. Wide plate testing of the heat affected zone of LT60 and A710 plate material.** Welding Inst. of Canada, Oakville, ON (Canada). 1986. 29p. (MICROLOG–87-00599). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

Four wide plate tests have been carried out on materials that could be used for Arctic applications such as offshore structures. The tests evaluated the heat affected zone (HAZ) behaviour of a high (A710) and a medium strength (LT60) steel. The tests were carried out on defects inserted in the heat affected zone designed to give cleavage failures at -30°C. The tests were carried out in the as-welded and stress relieved condition. The two tests on the high strength material did not produce failures as the strain was limited in the HAZ because of the very much undermatched weld metal strength. In this case all the deformation was occuring in the weld metal and only limited amount of ductile tearing took place at the tip of the HAZ defect. In the case of the LT60 material, cleavage failures occurred and the behaviour could be described in terms of the crack opening displacement design curve. In both cases the safety factor in terms of strain exceeded two. These analyses were carried out without including residual strain and the present tests would indicate that the inclusion of residual strain would be overly conservative. Further investigation of this factor is warranted because of the limited number of tests that the method of crack insertion. Similarly an analysis based on crack-tip opening displacement (CTOD) safety factors showed that although the HAZ had low toughness in the as-welded condition the full scale tests behaved at a much higher CTOD value. 13 refs., 15 figs., 5 tabs.

45507 Evidence for the formation of a metastable crystalline phase during crystallization of Zr-Ni metallic glasses of approximately 57-63.2 at. % Zr*. McKamey, C.G. (Metals and Ceramics Div., Oak Ridge National Lab., Oak Ridge, TN (US)); Easton, D.S.; Kroeger, D.M. vp. of Rapidly solidified alloys and their mechanical and magnetic properties. Giessen, B.C.; Polk, D.E.; Taub, A.I. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The crystallization of rapidly solidified Zr-Ni metallic glasses has been studied by differential scanning calorimetry (DSC), x-ray diffraction (XRD), and transmission electron microscopy (TEM). Evidence has been found for a metastable phase which is the first crystalline phase to form upon heating in compositions of 57 to 63.2 at. % Zr. This phase seems to be more easily formed and is most stable in the region of 58 to 59 at. % Zr. Upon subsequent heating to higher temperatures, the metastable phase transforms to the equilibrium phases ZrNi and Zr_2Ni. The relationship of this new phase to phase separation at the eutectic composition of 63.5 at. % Zr is discussed in support of the conclusions drawn from low temperature specific heat studies reported previously.

45508 Thermodynamics and kinetics of crystal-amorphous transformation in $A_{1-x}B_x$ alloys during reaction with hydrogen. Yeh, X.L. (Lab. for Engineering Materials, California Institute of Technology, Pasadena, CA (US)); Johnson, W.L.; Keck, W.M.; Tang, J.Y.; Shi, C.R. vp. of Rapidly solidified alloys and their mechanical and magnetic properties. Giessen, B.C.; Polk, D.E.; Taub, A.I. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The kinetics of amorphous phase formation in polycrystalline $A_{1-x}B_x$ (Z=Zr, Hf, B=Pd, Rh, .15<x<.25) alloys during reaction with hydrogen has been studied by x-ray diffraction, ^{+19}F nuclear reaction depth profiling, TEM and electron diffraction. The formation of the amorphous hydride phase is observed by TEM to begin at grain boundaries of the polycrystalline $Zr_{1-x}Rh_x$ much in the same manner that melting nucleates at grain boundaries. TEM micrographs further show that the phase boundary between the crystalline and amorphous phases remains sharp during the growth of the amorphous phase. Both x-ray diffraction and nuclear depth profiling studies suggest that the overall rate of transformation to the amorphous hydride phase is limited by the rate of hydrogen permeation through the sample surface.

45509 Characterization of inhomogeneities in amorphous superconductors. Alp, E.E. (Materials Science and Technology Div., Argonne National Lab., Argonne, IL (US)); Malik, S.K.; Lepetre, Y.; Shenoy, G.K.; Montano, P.A. vp. of Rapidly solidified alloys and their mechanical and magnetic properties. Giessen, B.C.; Polk, D.E.; Taub, A.I. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The structure and superconducting properties of rapidly quenched Zr-Ni and Zr-V alloys have been studied by XRD, EXAFS spectroscopy, TEM, electron diffraction, ED, electrical resistivity and ac susceptibility measurements. Amorphous $Zr_{66}Ni_{34}$ ribbons quenched with different cooling rates were also examined by flux pinning measurements. Characteristic differences are observed in the flux pinning mechanisms of microcrystalline and amorphous samples. The temperature dependence of upper critical fields have been measured down to 0.4 K and the results are analyzed in terms of WHH theory.

45510 Magnetic domain structures in cerium-doped $Fe_{80}B_{20}$, $Fe_{80}B_{16}Si_2C_2$ and $Fe_{78}B_{13}Si_9$ glassy ribbons. Canright, G.S. (Univ. of Tennessee, Dept. of Physics, Knoxville, TN (US)); Kroeger, D.M. vp. of Rapidly solidified alloys and their mechanical and magnetic properties. Giessen, B.C.; Polk, D.E.; Taub, A.I. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The addition of cerium in parts-per-million quantities has been shown to be effective in inhibiting the annealing embrittlement of melt-spun amorphous ribbons. The effects of cerium doping on magnetic domain structures are reported in this paper. Domain structures have been observed using the Bitter colloid technique on the free surfaces of as-quenched ribbons, as well as on both surfaces of ribbons which have been thinned by electropolishing. In the binary and quaternary alloys, the optimum (in terms of mechanical properties) cerium content gives ribbons which are apparently free of quenched-in stresses, since they lack the commonly observed maze domains which are found for both undoped and excessively doped ribbons. In contrast, the ternary alloy, which shows little decrease in annealing embrittlement versus doping, is free of maze domains in the as-quenched condition, with or without doping. The effect on the former two alloys is interpreted in terms of enhanced stress-relief during the quench.

45511 Formation of Icosahedral Al(Mn) by pulsed surface melting. Follstaedt, D.M. (Sandia National Labs., Albuquerque, NM

(US)); Knapp, J.A. vp. of Rapidly solidified alloys and their mechanical and magnetic properties. Giessen, B.C.; Polk, D.E.; Taub, A.I. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Surface melting of alternating Al/Mn layers on Al and Fe substrates by pulsed electron beams and laser is found by TEM to produce icosahedral Al(Mn). Interpreting the observed microstructures in terms of the calculated temperature histories places limits on the melting point of the phase ($660^0C < Tm < 960^0C$), the time needed for its nucleation from the melt at 660^0C ($t_n < 20$ ns), and the rate of quenching from the liquid needed to suppress formation of the competing T phase ($-T < -1 \times 10^6$ K/s).

45512 Fracture toughness of stainless steel welds. Mills, W.J. (Westinghouse Hanford Co., Richland, WA (US)). pp. 939 of Fracture mechanics. Cruse, T.A. ASTM, Philadelphia, PA (1988). (CONF-860675–: 19. national symposium on fracture mechanics (ASTM), 30 Jun - 2 jul 1986).

The effects of temperature, composition, and weld-process variations on the fracture toughness behavior for Types 308 and 16-8-2 stainless steel (SS) welds were examined using the multiple-specimen J-resistance-curve procedure. Fracture characteristics were found to be dependent on temperature and weld process, but not on filler material. Gas-tungsten-arc (GTA) welds exhibited the highest fracture toughness, a shielded-metal-arc (SMA) weld exhibited an intermediate toughness, and submerged-arc (SA) welds yielded the lowest toughness. Minimum expected fracture properties were defined from lower bound fracture toughness and tearing modulus values generated here and in previous studies. Fractographic examination revealed that microvoid coalescence was the operative fracture mechanism for all welds. Second-phase particles of manganese silicide were found to be detrimental to ductile fracture behavior because they separated from the matrix during the initial stages of plastic straining. In SA welds, the high density of inclusions resulting from silicon pickup from the flux promoted premature dimple rupture.

45513 Dynamic moire interferometry studies of stress wave and crack-tip diffraction events in 1018 steel. Epstein, J.S. (Idaho National Engineering Lab., Idaho Falls, ID (US)); Deason, V.A.; Reuter, W.G. pp. 939 of Fracture mechanics. Cruse, T.A. ASTM, Philadelphia, PA (1988). (CONF-860675–: 19. national symposium on fracture mechanics (ASTM), 30 Jun - 2 jul 1986).

A study of stress wave propagation around localized crack-tip regions in engineering materials is presented. The principal tool of this initial investigation is dynamic moire interferometry, which yields full-field continuum boundary conditions of surface displacement in a real-time optical processing manner. The displacement sensitivity employed for this study is 3.3 μm; however, the displacement sensitivity can be as high as 0.2 μm. The spatial resolution developed is less than 1 mm. After a brief review of the technique of dynamic moire interferometry, the study of a longitudinal pulse, interacting with an artificial crack in a finite steel bar, is presented. Equations for the near-tip elastic dynamic crack displacements are reexamined to extract localized elastic dynamic stress-intensity factors in light of the capabilities of dynamic moire interferometry.

45514 Microstructural characterization of rapidly solidified Type 304 stainless steel. Wright, R.N. (Idaho National Engineering Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)); Flinn, J.E.; Korth, G.E. vp. of Rapidly solidified alloys and their mechanical and magnetic properties. Giessen, B.C.; Polk, D.E.; Taub, A.I. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

The microstructures of rapidly solidified Type 304 stainless steel powders produced by vacuum gas (VGa) and centrifugal atomization (CA) have been examined. The solidification morphology and phase distribution have been characterized using optical and scanning electron microscopy, and the relative amounts of ferrite and austenite have been quantified using x-ray diffraction. Most CA powder particles contain both fcc and bcc phases, with the bcc phase predominating at small particle sizes and the fcc phase at large particle sizes. The VGA powder generally contains less ferrite, with very little dependence on the particle size. The ferrite was metastable and transforms to austenite on annealing at 900^0C.

45515 A method for determining the crack arrest fracture toughness of ferritic materials. Barker, D.B. (Univ. of Maryland, College Park, MD (US)); Fourney, W.L.; Irwin, G.R.; Chona, R.; Corwin, W.R.; Marschallo, C.W.; Rosenfield, A.R.; Wessel, E.T. pp. 939 of Fracture mechanics. Cruse, T.A. ASTM, Philadelphia, PA (1988). (CONF-860675–: 19. national symposium on fracture mechanics (ASTM), 30 Jun - 2 jul 1986).

This paper summarizes the results from a round robin test program that was conducted from 1983 through 1985 to evaluate a proposed ASTM standard test method for determining the crack arrest fracture toughness of ferritic materials. The round robin attracted a total of 27 participants from the United States, Canada, Europe, and Japan, each of whom agreed to test three specimens of A514 bridge steel, three specimens of A588 bridge steel, and six specimens of A533 Grade B, Class 1 reactor pressure vessel steel. Twenty-one participants had completed their testing and forwarded test results when this paper was written, which provided a data base consisting of 54 test results for each of the bridge steels at -30^0C, 70 test results for the reactor steel at 10^0C, and 65 test results for the reactor steel at 25^0C. This paper summarizes the test procedure followed in the round robin, discusses the results obtained, and provides the rationale for the modifications to the test method that were recommended in light of the experienced gained from this test program.

45516 Fracture analyses of Heavy-Section Steel Technology wide-plate crack-arrest experiments. Bass, B.R. (Oak Ridge National Lab., Oak Ridge, TN (US)); Pugh, C.E.; Merkle, J.G.; Naus, D.J.; Keeney-Walker, J. pp. 939 of Fracture mechanics. Cruse, T.A. ASTM, Philadelphia, PA (1988). (CONF-860675–: 19. national symposium on fracture mechanics (ASTM), 30 Jun - 2 jul 1986).

A series of wide-plate crack-arrest tests was recently completed by the Heavy-Section Steel Technology program at the National Bureau of Standards, Gaithersburg, MD, using tensile-loaded specimens of A533 Grade B Class 1 steel. Crack-arrest data were obtained at temperatures in the transition range and above the onset of the Charpy upper shelf, thereby providing a basis for the development and evaluation of improved fracture-analysis methods. The 1 b 1 by 0.102-m single-edge notched (SEN) specimens were welded to long straight pull tabs and subjected to a transverse linear temperature gradient before loading. The crack tips were sharpened by hydrogen-charging an electron-beam weld. The tests were designed to obtain crack arrest near the middle of the specimen where the temperature would produce a high-toughness level in the upper transition region of the material. The specimens were instrumented with strain gages and thermocouples. Initial static design calculations were made using textbook formulas.

45517 Developing an austenitic stainless steel for improved performance in advanced fossil power facilities. Maziasz, P.J. (Oak Ridge National Lab., TN (USA)). *Journal of Metals (USA)*, 41(7): 14-20 (Jul 1989).

Designed for application in the demanding environments of power-generating systems, new steels with outstanding high-temperature creep rupture resistance have been developed at Oak Ridge National Laboratory. Stemming from years of research on precipitation in aged and reactor-irradiated steels, the precipitate microstructure in Fe-Cr-Ni steels was effectively tailored through carefully controlled additions of minor alloying elements and with the assistance of analytical electron microscopy.

3602 Ceramics, Cermets, and Refractories

Refer also to citation(s) 44424, 44425, 44450, 44618, 44986, 45440, 45492, 45498, 45552, 45572, 46020, 46614, 46621, 46622, 46625, 46630

45518 (AD-A-207978/8/XAB) **Preparation and characterization of members of the system La(2-x)A(1+x) Cu_2O (+ or - y) where A = Ca,Sr. Technical report.** Doverspike, K.; Liu, J.H.; Dwight, K.; Wold, A. Brown Univ., Providence, RI (USA). Dept. of Chemistry. 12 May 1989. 13p. (TR–20). Available from NTIS, PC A03/MF A01.

Members of the system $La_{2-x}A_{1+x}Cu_2O_{6+y}$ where A = Ca, Sr were prepared by decomposition of the nitrates. The tolerance of

these compounds for oxygen uptake, as well as the substitution for the A-site ions, is shown to be closely related to the distribution of the alkali earth ions on the 8- and 9- coordinated A-sites.

45519 (AD-A–208078/6/XAB) **Valence, charge transfer, and carrier type for $Ni_2Sr_2Ca_{n-1}CuNO_2$(n+4+delta) and related high-temperature ceramic superconductors. Professional paper.** Jones, T.E.; McGinnis, W.C.; Boss, R.D.; Jacobs, E.W.; Schindler, J.W. Naval Ocean Systems Center, San Diego, CA (USA). 30 Sep 1988. 13p. Available from NTIS, PC A03/MF A01.

Pub. in American Chemical Society, No. 377, 155-167(25-30 Spr 1988).

Samples of the bismuth based high-temperature superconducting family $Bi_2Sr_2Ca_{n-1}CuNO_2$(n+4 delta) have been prepared and characterized by x-ray diffraction, and temperature-dependent resistivity and thermoelectric-power measurements. Both of the high temperature superconducting phases reported in the literature, with transition temperatures near 80 and 110K, were observed. Evidence from thermoelectric power measurements is presented which shows that this family of ceramic superconductors has contributions to the electrical transport that is both electron-like and hole-like. However, all of the superconducting transitions observed involve hole-like states.

45520 (AD-A–208113/1/XAB) **Preparation of hafnium carbide by dynamic compaction of combustion synthesized materials. Final report.** Benck, R.F.; Kecskes, L.J.; Netherwood, P.H. Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab. Jun 1989. 36p. (BRL-MR–3764). Available from NTIS, PC A03/MF A01.

Solid hafnium carbide was produced by explosive compaction of Self-Propagating High-Temperature Synthesis (SHS) produced material. The experimental technique is described and various parameters that affect the dynamic compaction are discussed. Densities greater than 90% theoretical were attained, but some samples exhibited poor interparticle bonding and cracking. It is concluded that the amount of heat given off by the SHS reaction is insufficient to both propagate the synthesis process and properly sinter the SHS product.

45521 (AD-A–208232/9/XAB) **Preparation of boron-containing ceramic materials by pyrolysis of the decaborane(14)-derived (-B10H12.Ph_2POPPh2)(x)-polymer. Professional paper.** Seyferth, D.; Rees, W.S.; Haggerty, J.S.; Lightfoot, A. Massachusetts Inst. of Tech., Cambridge, MA (USA). Dept. of Chemistry. 1989. 17p. (TR–29). Available from NTIS, PC A03/MF A01.

Pub. in Chemistry of Materials, Vol. 1, No. 1, 45-52(1989).

The pyrolysis of the known polymer (-$B_{10}H_{12}.Ph_2POPPh_2$)(x)- to give a boron-containing ceramic was studied. The pyrolysis to 1000 C gives an amorphous solid in 93% ceramic yield that contains boron, phosphorus, oxygen, and a large excess of carbon. Further studies devoted to this material have served to characterize it with respect to surface area, pore size and distribution, density, grain size, crystalline phases, and elemental composition as a function of the temperature up 2350 C.

45522 (CONF-890718–25) **Defect structures preceding amorphization by ion irradiations in $YBa_2Cu_3O_{7-\delta}$.** Kirk, M.A.; Frischherz, M.C.; Liu, J.Z.; Funk, L.L.; Thompson, L.J.; Ryan, E.A.; Ockers, S.T.; Weber, H.W. Argonne National Lab., IL (USA). Jun 1989. 3p. Sponsored by DOE/ER;NSF. DOE Contract W-31109-ENG-38. From International conference on materials and mechanisms of superconductivity - high-temperature superconductors; 23-28 Jul 1989. Order Number DE89016905/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Transmission electron microscopy was used to investigate defect microstructures in single crystals of $YBa_2Cu_3O_{7-\delta}$ as a function of ion irradiation dose at 300 K. Two qualitatively different defect microstructures were observed to precede amorphization. The transition between microstructures occurs at a damage level where published resistance versus temperature measurements indicate a transition from superconducting to insulating behavior. 3 refs., 1 fig.

45523 (CONF-890995–1) **Structure-mechanical property relationships in ion implanted ceramics.** McHargue, C.J.; White, C.W.; Sklad, P.S.; O'Hern, M.E.; Joslin, D.L.; Farlow, G.C. Oak Ridge National Lab., TN (USA). [1989]. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 2. international seminar on surface engineering by high energy beams; 5-7 Sep 1989. Order Number DE89010129/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Although the majority of research and development involving ion implantation has been devoted to the doping of semiconductors, there has also been much activity toward altering the chemical, physical, and mechanical properties of metals and alloys. In recent years, there has been a resurgence of interest in the use of ion beams to alter the properties of insulating materials. As a class of materials, insulators exhibit a range of properties, structures, phases, chemical bonding types, etc. This paper will consider the portion of that class called ceramics, primarily the crystalline oxides and carbides that find technological applications today. 30 refs., 10 figs., 1 tab.

45524 (DOE/ER/45063–1) **Characterization of pore evolution in ceramics during creep failure and densification: Progress report.** Page, R.A.; Lankford J. Jr.; Chan, K.S. Southwest Research Inst., San Antonio, TX (USA). Nov 1984. 31p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-84ER45063. Order Number DE89016275/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Rice has pointed out that the failure of ceramics is a weak link process, and that frequently, the number, distribution, size(s), and shapes of inherent pores within a ceramic body constitute its principal weak links. General (average) porosity has been specifically identified as a controlling parameter in compressive failure under ambient conditions, and since local compressive failure usually is involved in wear, particle impact, and abrasive damage modes, average porosity should be very important under these circumstances as well. However, porosity-induced tensile failure at low homologous temperatures is concerned with largest pore, or pore cluster, sizes. On the other hand, failure of ceramics during creep at elevated temperatures, under all states of stress, is very sensitive to average porosity; such failure involves the nucleation, growth, and eventual coalescence of multiple pores. Creep lifetime prediction, therefore, involves the estimation of the kinetics of the latter cavitation processes. In this report, experimental evidence concerning the creep failure of high strength ceramics will be reviewed, and theoretical failure models will be outlined. By analyzing the predictions of the models, parameters which should exert primary control over failure can be specified. Consideration of these factors will establish the experimental test conditions which should permit discrimination between competing theoretical possibilities. Pore evolution during sintering/processing will be discussed. 95 refs., 1 fig.

45525 (DOE/ER/45069–3) **Effect of microstructure on mechanical properties of silicon nitride ceramics: Final report for period April 1, 1984 through March 31, 1988.** Tien, T.Y. Michigan Univ., Ann Arbor, MI (USA). Dept. of Materials Science and Engineering. May 1988. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-84ER45069. Order Number DE89016787/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The goal of this project was to study the effect of silicon nitride grain morphology and the nature of the grain boundary phase on the mechanical properties of silicon nitride ceramics. A complete study on sintering and grain growth has been conducted in two silicon nitride systems: SiAlON – $Y_3Al_5O_{12}$ (YAG) and SiAlON – Cordierite. The two additives, YAG and cordierite, were selected so that the liquid viscosity during sintering is relatively high in the cordierite system. Extensive kinetic characterization on densification, alpha and beta silicon nitride phase transformation and grain growth has been obtained with respect to sintering temperature and time, sialon composition, and liquid viscosity and content. The growth anisotropy of the → grain has been demonstrated and the possible mechanistic explanation have been addressed.

45526 (DOE/SF/17169–T13) **Thermionic Insulator Development and Evaluation (TIDE): Final report.** Witt, T. Rasor Associates, Inc., Sunnyvale, CA (USA). 31 Jul 1989. 48p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC03-87SF17169. (NSR–41/89-0721). Order Number DE89016493/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

The TIDE program was initiated as a cooperative effort between Rasor Associates, Inc. and Los Alamos National Laboratory to establish procedures to evaluate insulating materials for high temperature energy conversion applications. Electrical conductivity for alumina in ex-reactor as well as neutron irradiated testing was to be combined with microstructural analysis to gain an understanding of the mechanisms leading to the degradation of insulating properties. This report covers the efforts toward these goals at Rasor Associates. Los Alamos' results will be reported separately. The primary result of efforts at RAI was the development and fabrication of a functional test apparatus for electrical conductivity measurements of highly resistive materials. Three alumina sample holders were designed and constructed to fixture guarded planar specimens for electrical testing. These holders can be used to at least 1800 K and can maintain vacuum or gaseous atmosphere. Three test ovens were constructed and supplied with power supplies and controllers. Two ovens may be used in the room temperature to 1300 K range while the third may be accurately controlled in the 1200–1800 K range. A system to apply platinum electrodes to the sample surfaces was developed. Apparatus to fixture and silkscreen the guarded electrodes was designed and fabricated. 6 refs., 17 figs.

45527 (IC–89/49) **Macroscopic persistent currents in high temperature ceramic superconductors.** Saif, A.G. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 8p. Order Number DE89636232/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

We study the macroscopic persistent currents (PC) in a thick cylindrical shell of ceramic high temperature superconductors (HTS) in the framework of a generalized Ginzburg-Landau theory (GGL), based on the coexistence of antiferromagnetism and superconductivity. It is shown that, in the absence of the applied magnetic field, the PC differ in nature from the current associated with the Meissner effect. Moreover, we found that the maximum PC is greater than the critical PC. This study may serve for further technological progress with HTS. (author). 29 refs.

45528 (INIS-BR–1592) **Study of hyperfine interactions in V_2O_3 by angular correlation.** Jesus Silva, P.R. de. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1985. 88p. (In Portuguese). Order Number DE89636233/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The hyperfine interaction in v_2O_3 in function of temperature by measurements of time differential perturbed angular correlation is studied. The samples presented quadrupole interaction in the probe center, Cd^{111} immediatelly after sintering, when reduced in H_2 flux at 800^0C. A pure electric quadrupole interaction at the metallic phase and a combined interaction of magnetic dipole and electric quadrupole at the insulating antiferromagnetic phase, were observed. The electric field gradient undergoes abrupt variation at the metal-insulating transition at $T=160^0$K from $8.2x10^{17}$v/cm^2 at the insulating phase to $6.3x10^{17}$v/cm^2 in the metallic phase, however varies smoothly with the temperature at $T=450^0$K when variations in resistivity also occur. At metallic phase the electric field increases with the temperature enhacement. The hyperfine magnetic field of Cd^{111} at antiferromagnetic phase of V_2O_3 has a saturation value of 15(1) KOe and performes an angle of $\beta=68(2)^0$ with the main component direction of electric field gradient. (M.C.K.).

45529 (INIS-BR–1604) **Production and mechanical properties of sintered carbides (hard steels WC-Co).** Batalha, G.F. Santa Catarina Univ., Florianopolis, SC (Brazil). Dept. de Engenharia Mecanica. Sep 1987. 247p. (In Portuguese). Order Number DE89636230/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Densification and mechanical characteristics or WC-Co Cemented Carbides, were investigated by dilatometry, Hardness and bending tests, as a function of the two principal micro-structural parameters: the cobalt content and the particle size of carbide crystals. Vickers hardness of the studied compositions showed a linear variation with the increase of the cobalt content. By three point bending, the transverse rupture strenght increases with cobalt content, however, for larger grain size reaches a maximum, eventually reduced by brittle phases and incomplete dispersion. The results of brittle facture tests were statistically analised and fitted better to the 'Weakest Link Model' (Weibull distribution) than the 'Chain Model' (Gaussian distribution). (author).

45530 (IPEN-PUB–235) **Techniques for the identification of corrosion products.** Ramanathan, L.V. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Dec 1988. 38p. (In Portuguese). Order Number DE89636235/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This paper presents the different techniques that can be used to identify corrosion/oxidation products through determination of either their composition or their structure, chemical analysis and spectrochemical analysis are commonly used to determine the composition of gross corrosion products. Surface anaLysis techniques such as electron microprobe, AES, ESCA, SIMS, ISS, neutron activation analysis, etc., can be used not only to detect the concentration of the various elements present, but also to obtain the concentration profiles of these elements through the corrosion products. The structure of corrosion products is normally determined with the aid of either X-ray or electron diffraction techniques. This paper describes the basic principles, typical characteristics, limitations and the types of information that can be obtained from each of the techniques along with some typical examples. (author).

45531 (IPEN-PUB–247) **Bi-Sr-Ca-Cu-O superconducting ceramics.** Muccillo, R.; Muccillo, E.N.S.; Bressiani, J.C.; Gomes, L.; Morato, S.P. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Feb 1989. 12p. (In Portuguese). Order Number DE89636225/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

$BiSrCaCu_2O_x$ ceramic samples with a superconducting phase at 107K have been sinthesized. The critical temperature has been determined by Meissner effect measurements. That same 107K phase has also been detected in the following compounds: $Bi_2Sr_2Ca_2Cu_3O_x$ and $Bi_{3.6}Sr_{2.7}Ca_{2.7}Cu_{2.7}Cu_4O_x$. (author).

45532 (KFK–4573) **The determination of the dielectric parameters of ceramic materials by Q-meter measurements.** Heidinger, R. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Material- und Festkoerperforschung; Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion. Jun 1989. 42p. Order Number DE89915149/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A measuring facility based on a Q-meter system is described that provides the determination of the dielectric parameters of ceramics in the frequency range of 1-70 MHz. The dielectric parameters, the permittivity ϵ_r' and the loss tangent tan δ, are required for the selection of appropriate ceramic components in heating systems for nuclear fusion plasmas based on Ion-Cyclotron-Resonance Heating. The theory of dielectric measurements by Q-meters is presented in detail. Further the basic formulae for the transformation of the measurable variables into ϵ_r' and tan δ are developed for specimens with shapes of discs and rings. Their validity is checked for samples with diameters in the range of 30-50 mm and thicknesses in the range of 1-5 mm. A correction scheme is proposed for accounting for the influence of field distortion on the permittivity. The influence of statistical and systematic errors are investigated, and it is found that the uncertainties introduced by the correction of field distortion dominate for ϵ_r', whereas for tan δ the statistical error is generally most important. The accuracy achieved for ϵ_r' is better than +- 0.3, and the relative error of tan δ amounts to <10% for tan δ values in the range of 10^{-3}-10^{-4} (orig.).

45533 (LA-UR–89-2691) **Characterizations of shock-loaded aluminum-infiltrated boron carbide cermets.** Blumenthal, W.R.; Gray, G.T. III. Los Alamos National Lab., NM (USA). 1989. 10p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-890812–31: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016773/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Shock-recovery experiments were performed on aluminum-infiltrated B_4C cermets as a function of shock pressure and composition. The effect of strain rate under uniaxial stress loading was also studied. Compressive strength was determined to be insensitive to strain rate between 10^{-3} and 10^3 s^{-1}. TEM examination revealed dislocation debris and twins in a few B_4C grains

aftershock-loading above an upper bound HEL estimate. Below this shock pressure the B_4C substructure responded elastically. Elastic moduli and strengths were highly dependent on the fraction of B_4C in the cermets. However, high yield and failure strains and limited fragmentation after shock loading attest that the aluminum phase contributes significantly to the strength and integrity. 4 refs., 3 figs.

45534 (LA-UR-89-2929) **Intergranular and interphase boundaries in ceramics.** Mitchell, T.E.; Roy, T.; Unal, O. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890977-1: International congress on intergranular and interphase boundaries in materials, 4-8 Sep 1989). Order Number DE89016969/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Interfaces are of great importance in both electronic and structural ceramics. The microstructure and microchemistry of interfaces can be studied by transmission electron microscopy, both high resolution and analytical. Examples are taken from both intergranular and interphase boundaries in ceramics. The former include low angle, twin and 90° boundaries in $YBa_2Cu_3O_7$ superconductors. Interphase boundaries include epitactic layers of $YBa_2Cu_3O_7$ on $SrTiO_3$ and $LaGaO_3$ and non-oriented interfaces such as occur in coatings and composites. 13 refs., 10 figs.

45535 (N-89-21895) **Effect of processing on fracture toughness of silicon carbide as determined by Vickers indentations.** Dannels, C.M.; Dutta, S. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. May 1989. 18p. (NASA-TM-101456;E-4565;NAS-1.15:101456). Available from NTIS, PC A03/MF A01.

Several alpha-SiC materials were processed by hot isostatic pressing (HIPing) and by sintering an alpha-SiC powder containing boron and carbon. Several beta-SiC materials were processed by HIPing a beta-SiC powder with boron and carbon additions. The fracture toughnesses K(sub 1c) of these beta- and alpha-SiC materials were estimated from measurements of Vickers indentations. The three formulas used to estimate K(sub 1c) from the indentation fracture patterns resulted in three ranges of K(sub 1c) estimates. Furthermore, each formula measured the effects of processing differently. All three estimates indicated that fine-grained HIPed alpha-SiC has a higher K(sub 1c) than coarsed-grained sintered alpha-SiC. Hot isostatically pressed beta-SiC, which had an ultrafine grain structure, exhibited a K(sub 1c) comparable to that of HIPed alpha-SiC.

45536 (ONRL-8-016-R) **Engineering Materials for Very High Temperatures: an ONRL Workshop.** Cartz, L. Office of Naval Research (USA). London Branch Office. 1988. 79p. (CONF-8808224--: ONRL workshop on engineering materials for very high temperatures, 29 Aug 1988). Available from NTIS, PC A05/MF A01.

The limitations of present-day materials at high temperatures are reviewed. Silicon nitride based ceramics, silicon carbide, and carbon materials are discussed. Near-term and long-term studies are described to improve the performance at temperatures above 1400 C of monolithic ceramics, composites, and ceramic coatings.

45537 (ORNL/FTR-3351) **[Fifth International workshop on glasses and ceramics from gels, Rio de Janeiro, Brazil, August 6-10, 1989]: Foreign trip report.** Harris, M.T. Oak Ridge National Lab., TN (USA). 15 Aug 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016899/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the Fifth International Workshop on Glasses and Ceramics from Gels and presented a paper. Papers of specific interest to ORNL involved the sol-gel processing of sulfides, the formation of ceramic precursors from emulsions and sol-gel film formation. These papers may be useful in the synthesis of advanced ceramics and in improving thin film coatings.

45538 (ORNL/TM-11053) **A study of the tribological and surface micromechanical properties of $YBa_2Cu_3O_{7-x}$: Final report.** Blau, P.J.; DeVore, C.E.; Wilson, D.F.; Keiser, J.R. Oak Ridge National Lab., TN (USA). Jul 1989. 40p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. Order Number DE89015680/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The burgeoning interest in high critical temperature (T_c) superconductors has created a need to examine the technological properties of these materials for the purpose of defining potential applications and handling characteristics. While new superconducting compounds continue to be developed, the perovskite-structure oxide ceramics form the basis for these new materials. This report discusses information obtained about the reciprocating sliding friction coefficients (self-mated and on gold), scratch resistance, microindentation hardness, and wear damage mechanisms in $YBa_2Cu_3O_{7-x}$ compounds fabricated in several ways. As expected, the materials are quite brittle. Knoop microindentation hardness numbers for single crystals can exceed 4.41 GPa (450 kg/mm^2). Low-load, precision indentation experiments provided information on the hardness of thin surface regions less than 300 nm deep, as well as on the modulus of elasticity. The modulus of elasticity obtained by indentation experiments was 78 to 81 GPa, which is in relatively good agreement with density-corrected published values obtained by ultrasonic methods. Scratch resistance using a diamond stylus test falls with increasing load because both intergranular and transgranular cracking increase with load. The abrasion rate of $YBa_2Cu_3O_{7-x}$ on 180-grit silicon carbide papers is linearly proportional to normal load. Overall results confirm that the $YBa_2Cu_3O_{7-x}$ materials are brittle in their monolithic form, and their use in tribological applications should be avoided unless a suitable, more damage-tolerant composite can be developed. 23 refs., 22 figs., 3 tabs.

45539 (PB-89-866008/XAB) **Ceramic bearings. June 1970-July 1989 (Citations from the NTIS data base). Report for June 1970-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 106p. Available from NTISPC N01/MF N01.

Supersedes PB-88-866413.

This bibliography contains citations concerning bearings and bearing surfaces fabricated from ceramic materials. Design, testing, and applications of ceramic bearings are included. An analysis of various ceramic materials used for these bearings and performance evaluations of the various materials are also included. (This updated bibliography contains 181 citations, 35 of which are new entries to the previous edition.)

45540 (PB-89-866123/XAB) **Chemical vapor deposition. August 1984-July 1988 (Citations from the NTIS data base). Report for August 1984-July 1988.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 244p. Available from NTISPC N01/MF N01.

See also PB-89-866131.

This bibliography contains citations concerning chemical vapor deposition of carbon, carbides, ceramics, metals, and glasses. Applications include optical coatings, semiconducting films, laser materials, solar cells, composite fabrication, and nuclear-reactor-material fabrication. Included are the physical, mechanical, and chemical properties of these coatings. (This updated bibliography contains 385 citations, none of which are new entries to the previous edition.)

45541 (PB-89-866131/XAB) **Chemical vapor deposition. August 1988-July 1989 (Citations from the NTIS data base). Report for August 1988-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 72p. Available from NTISPC N01/MF N01.

Supersedes PB-88-866603. See also PB-89-866123.

This bibliography contains citations concerning chemical vapor deposition of carbon, carbides, ceramics, metals, and glasses. Applications include optical coatings, semiconducting films, laser materials, solar cells, composite fabrication, and nuclear-reactor-material fabrication. Included are the physical, mechanical, and chemical properties of these coatings. (This updated bibliography contains 106 citations, all of which are new entries to the previous edition.)

45542 Interband optical conductivity of $Bi_2CaSr_2Cu_2O_8$. Ching, W.Y. (Missouri Univ., Kansas City, MO (USA). Dept. of Physics); Zhao, G.L.; Xu, Y.N.; Wong, K.W. *Modern Physics Letters B (USA)*, 3(3): 263-269 (10 Mar 1989).

The band structure and interband optical conductivity of $Bi_2CaSr_2Cu_2O_8$ superconductor in the body-centered tetragonal sub-unit is calculated self-consistently using orthogonalized linear combination of atomic orbitals method. The result shows $Bi_2CaSr_2Cu_2O_8$ has both semi-metal-like and semiconductor-like features with small band gap and band overlap. The interband optical conductivity shows strong anisotropy between the in-plane and z-direction components. A plasmon frequency at 6 eV is predicted.

45543 Temperature dependence of the magnetic excitations in $La_{1.85}Sr_{0.15}CuO_4$ (T_c=33 K). Shirane, G. (Brookhaven National Laboratory, Upton, New York, 11973(US)); Birgeneau, R. J.; Endoh, Y.; Gehring, P.; Kastner, M. A.; Kitazawa, K.; Kojima, H.; Tanaka, I.; Thurston, T. R.; Yamada, K.; and others. *Physical Review Letters (USA),* 63(3): 330-333 (17 Jul 1989). DOE Contract AC02-76CH00016.

Using neutron-scattering techniques, we have studied the temperature dependence of the magnetic excitations at varied energies in a high-quality single crystal of $La_{1.85}Sr_{0.15}CuO_4$. This crystal exhibits a sharp superconducting transition at 33 K with nearly 100% flux exclusion. For magnetic excitation energies of 9 meV and lower, the intensity drops dramatically with decreasing temperature for temperatures below ~150 K. However, at 12 MeV the intensity is independent of temperature between 300 and 5 K.

45544 Changes in physical properties of the high-T_c superconductor Y-Ba-Cu-O due to Cu deficiency. Yao, Y.D. (State Univ. of New York, Stony Brook, NY (USA). Dept. of Physics); Kao, Y.H.; Simmins, J.J.; Snyder, R.L.; Tao, Z.; Jones, K.W. *Modern Physics Letters B (USA),* 3(6): 499-503 (20 Apr 1989).

Stoichiometry of the well-known high-T_c compound $YBa_2Cu_3O_y$ is modified by varying the Cu concentration in the system, and changes in the oxygen content and superconducting properties are investigated. The oxygen content shows a nonlinear dependence on the Cu concentration. For Cu deficiency up to 20%, the transition temperature T_c remains at a nearly constant value of 93 K. X-ray diffraction measurements show that the compound is orthorhombic in this range of stoichiometric variation, and the Cu-deficient superconductor is single phase. The room temperature resistivity increases exponentially while the critical current density decreases exponentially with increasing Cu deficiency. These results indicate that the predominant mechanism for high-T_c superconductivity is closely related to the local structure around the Cu and O atoms.

45545 Preparation of superconducting thick films of $YBa_2Cu_3O_7$ by deposition of a superconducting precursor ink. Dabrowski, B. (Argonne National Lab., IL (USA)); Hinks, D.G. *Modern Physics Letters B (USA),* 3(6): 509-513 (20 Apr 1989).

A simple and reliable method of producing good quality superconducting thick films of $YBa_2Cu_3O_7$ with zero resistance above 87 K is presented. The method consists of dipping, spraying or painting a superconducting precursor ink on a substrate (of arbitrary dimensions) with subsequent sintering in flowing oxygen at temperatures close to the melting temperature of $YBa_2Cu_3O_7$. Superconducting transition temperatures (T_c) as a function of substrate material, firing temperature and nature of the precursor ink are discussed BeO was found to be the best substrate for our process.

45546 Hexagonal $LiMoO_2$: A close-packed layered structure with infinite Mo-Mo-bonded sheets. Aleandri, L.E. (Department of Energy, Ames, IA (USA)); McCarley, R.E. *Inorganic Chemistry (USA),* 27(6): 1041-1044 (23 Mar 1988). DOE Contract W-7405-ENG-82.

A new compound, $LiMoO_2$, with hexagonal layered structure has been prepared by reaction of Li_2MoO_4 with Mo metal at 900°C for 21 days. Neutron powder diffraction Rietveld analysis shows that $LiMoO_2$ is isomorphous with α-$NaFeO_2$; space group $R\bar{3}m$, a = 2.8663 (1) Å, c = 15.4743 (5) Å, Z = 3. The structure consists of cubic close-packed oxide layers with Mo and Li atoms occupying octahedral sites between alternate layers. Each Mo atom is thus bonded to six other Mo atoms in a hexagonal sheet with d(Mo-Mo) = 2.8663 (1) Å. The Mo-O and Li-O distances are 2.0520 (9) and 2.146 (1) Å, respectively. DOS and COOP curves from extended Hueckel band calculations indicate that all Mo-Mo bonding states are filled within the O-Mo-O slabs. 20 refs., 5 figs., 1 tab.

45547 Phonon-dislocation interaction in deformed lithium fluoride. Yang, I. (Department of Physics, University of Illinois at Urbana-Champaign, 1110 West Green Street, Urbana, Illinois 61801(US)); Anderson, A. C.; Kim, Y. S.; Cotts, E. J. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 1297-1300 (15 Jul 1989). DOE Contract AC02-76ER01198.

The thermal conductivity has been measured over the temperature range0.06–6 K for a LiF crystal before and after deformation by compressionin which all possible dislocation-slip planes were activated, and afterreduction in sample size and, finally, following γ-ray irradiation. Attemperatures below 1 K the results are in agreement with a model of phononscattering by fluttering dislocations. At $T \geq 1$ K the data suggest thatdislocation dipoles may dominate the scattering of phonons.

45548 Magnetic properties of the superconducting "superoxide" $La_2CuO_{4+\delta}$. Ansaldo, E. J. (Department of Physics, University of Saskatchewan, Saskatoon, Saskatchewan, Canada S7N0K3 (CA)); Brewer, J. H.; Riseman, T. M.; Schirber, J. E.; Venturini, E. L.; Morosin, B.; Ginley, D. S.; Sternlieb, B. *Physical Review [Section] B: Condensed Matter (USA),* 40(4): 2555-2557 (1 Aug 1989).

The magnetic properties of $La_2CuO_{4+\delta}$ ($\delta \leq 0.13$) have been determined by means of muon-spin rotation and relaxation in transverse and zero external fields. A fraction f_{SC}=0.6 of the sample was found to be superconducting with T_c=35(1) K and extrapolated penetration depth $\lambda(0)$=4200 Å (powder average). The other phase, 40% of the sample volume, displayed static magnetic ordering identical to that of oxygenated La_2CuO_4. The T dependence of λ is similar to that for samples of the $La_{2-x}Sr_xCuO_4$ family.

45549 Direct evidence of anomalous Cu-O vibrational modes near T_c in $ErBa_2Cu_3O_{7-\delta}$. Sharma, R. P. (Materials Science Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Rehn, L. E.; Baldo, P. M.; Liu, J. Z. *Physical Review Letters (USA),* 62(24): 2869-2872 (12 Jun 1989). DOE Contract W-31-109-ENG-38.

Ion channeling along the c axis in $ErBa_2Cu_3O_{7-\delta}$ reveals a normal (Debye-type) temperature dependence for thermal vibrations of the Er and Ba atoms between 40 and 300 K. In contrast, a substantially stronger than normal temperature dependence is found for the Cu-O atom vibrations, and a large, anomalous change (~30%) is seen at the superconducting transition. The large magnitude of the vibrational changes found for the Cu-O rows across T_c suggests that the atoms in these rows become strongly coupled in the superconducting state.

45550 Process for fabrication of large titanium diboride ceramic bodies. Moorhead, A.J.; Bomar, E.S.; Becher, P.F. To Dept. of Energy, Washington, DC. USA Patent 4,812,280. 14 Mar 1989. Filed date 17 Apr 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A process for manufacturing large, fully dense, high purity TiB_2 articles by pressing powders with a sintering aid at relatively low temperatures to reduce grain growth. The process requires stringent temperature and pressure applications in the hot-pressing step to ensure maximum removal of sintering aid and to avoid damage to the fabricated article or the die.

3606 Other Materials

Refer also to citation(s) 44440, 44450, 44904, 44907, 44908, 44997, 45005, 45010, 45411, 45492, 45540, 45541, 45590, 45631, 45719, 45776, 45859, 45862, 46036, 46414, 46611, 46612, 46613

45551 (AD-A–207907/7/XAB) **Explanatory research on the protection of carbon-carbon composites against oxidation at very high temperatures (>3000 deg f) with engel-brewer and other intermetallic compounds. Final report.** St Pierre, G. Ohio State Univ., Columbus, OH (USA). Dept. of Materials Science and Engineering. Jun 1988. 205p. Available from NTIS, PC A10/MF A01.

Iridium-based coatings have been proposed for the protection of carbon/carbon composites against oxidation at temperatures greater than 1600 C. However, Ir exposed to an oxidizing atmosphere at such high temperatures reacts with oxygen to form volatile oxides. Alloying Ir with a reactive element that forms a protective scale has been proposed as a method to prevent the evaporation of iridium-base coatings. Hafnium and Zr were suggested as possible alloying

elements. Investigations of the Ir-Hf and the Pt-Zr systems, however, have shown that Hf and Zr are only moderately protective. In both systems the reactive element, Hf and Zr, did not form a highly protective oxide scale. Aluminum is another possible alloying addition for the prevention of evaporation of the noble metal suboxides. Samples of C/C composite would be coated with HfC and then a layer of Iridium would be applied. It has been demonstrated that an adherent layer of Ir_3Hf can be grown between these coatings. The surface of the Ir would be impregnated with A1 and Cr.

45552 (AD-A–208119/8/XAB) **Highly oriented fiber-reinforced ceramic composites. Final report, 1 August 1988-31 January 1989.** Lee, R.R.; Hodge, J.D.; Wei, W.C.J.; Halloran, J.; Schutzberg, F. Ceramics Process Systems Corp., Cambridge, MA (USA). 31 Mar 1989. 79p. (CPS–89-004). Available from NTIS, PC A05/MF A01.

Highly dense SiC-AlN alloys having unique microstructures and a fracture toughness up to 6 MPam 1/2 were successfully produced by pressureless sintering of commercially available SiC and AlN powders. Appropriate sintering aids, sintering temperatures, sintering period and sintering conditions were identified. The sintered SiC-AlN alloys can achieve a single phase solid solution after an appropriate thermal treatment. The lattice constants of the solid solution varied linearly with SiC/AlN ratio. Optimized annealing yielded decomposition of the solid solution and formed a unique microstructure, which was composed of equiaxed grains with modulated features, heavily faulted elongated grains and very clean grain boundaries.

45553 (AERE-R–13286) **Effects of radiation on the mechanical properties of polymers used as electrical cable insulation and jacketing materials.** Johnson, D.I. UKAEA Harwell Lab. (UK). Materials Development Div. Jan 1989. 24p. (CFS/TWP–88-P53). Available from H.M. Stationery Office, London, price Pound 8.00.

The purpose of this report is to summarise briefly the available information on the effects of radiation on polymers which are being considered for use, or are used, in nuclear power plant. Data are presented in such a way as to indicate whether dose-rate effects are likely to occur. Information has been obtained from a variety of sources and is supplemented in some cases by data generated in current Harwell work carried out for a General Nuclear Safety Research programme. (author).

45554 Time-resolved study of surface recombination at Si(111) surfaces. Halas, N.J. (AT & T Bell Laboratories, Holmdel, NJ (USA)); Bokor, J. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

At present, the technologically important phenomenon of nonradiative surface recombination at semiconductor surfaces and interfaces is very poorly understood. Since the phenomenon was initially described by Shockley, Bardeen, and others over 30 years ago, knowledge of the basic physics has progressed surprisingly little. The authors have endeavored to obtain a complete microscopic understanding of surface recombination at a semiconductor surface, including knowledge of the surface-state electronic structure and the detailed kinetics of the bulk-surface transfer of charge carriers. The Si(111) cleaved surface is an excellent model system for this study since the surface electronic structure is extremely well-known experimentally and theoretically. There is a single intrinsic mid-gap state at 0.45 eV above the bulk valence band maximum (vbm) which is labelled π^*. Previously, infrared radiation was used to selectively excite the π^* state without exciting the bulk and the details of its decay kinetics were measured. They have now directly observed the role played by this state in surface recombination of bulk electrons and holes. 1 ref.

45555 (CONF-8909174–1) **Morphological aspects of the friction of hot-filament-grown diamond thin films.** Blau, P.J.; Yust, C.S.; Clausing, R.E. Oak Ridge National Lab., TN (USA). 1989. 10p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 16. Leeds-Lyon symposium on tribology; 5-8 Sep 1989. Order Number DE89015986/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent developments in chemical vapor deposition (CVD) technology have made it possible to produce thin diamond film on a variety of substrate materials. Diamond, having a very high hardness and low sliding friction coefficients, is a good candidate for tribological applications. Diamond films produced by a hot-filament CVD method often have irregular surfaces owning to the preferred growth mode of the crystals which form on the surface. This investigation using sapphire and bearing steel spherically tipped sliders demonstrated that the morphology of the diamond film surface produced friction coefficient up to ten times those observed in previous experiments which involved smooth diamond surfaces sliding against various solids in air. 12 refs., 8 figs., 1 tab.

45556 (IAEA-TECDOC–512, pp. 9-19) **Needs for analytical chemistry in silicon electronics technology.** Mitchell, J.W. (AT and T Bell Labs., Murray Hill, NJ (USA)). International Atomic Energy Agency, Vienna (Austria). Jun 1989. (CONF-8710491–: Consultants' meeting on the need for intercomparison and reference materials for characterization of silicon, 2-3 Oct 1987). In *Analytical chemistry in semiconductor manufacturing: Techniques, role of nuclear methods and need for quality control. Report of a consultants' meeting on the need for intercomparison and reference materials for characterization of silicon held in Gaithersburg, Maryland, USA, 2-3 October 1987.* Order Number DE89634686/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Widespread needs for analytical and defect characterizations for quality control of raw materials, processes, and the environment for silicon device manufacture are discussed generally. Emphasis is focussed on acquainting the nuclear analytical chemist with existing challenges in trace characterizations for the electronics industry. Continuing opportunities are cited for analytical methods development, certification of new standard reference materials, and international collaborations in developing universally accepted analytical methods. Collaborative programs potentially suited for initiation by the International Atomic Energy Agency are mentioned. (author). 20 refs, 4 figs, 7 tabs.

45557 (IC–89/62) **Thermal expansion of LATGS crystals.** Kassem, M.E.; Kandil, S.H.; Hamed, A.E.; Stankowska, J. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 17p. Order Number DE89636239/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The thermal expansion of triglycine sulphate crystals doped with L-α alanine (LATGS) has been studied around the phase transition temperature (30-60 deg. C) using thermomechanical analysis TMA. With increasing the content of admixture, the transition temperature (T_c) was shifted towards higher values, while the relative changes in the dimension of the crystals ($\Delta L/L_0$) of the studied directions varied both in the para- and ferroelectric phases. The transition width in the case of doped crystals was found to be broad, and this broadening increases with increasing the content of L-α alanine. (author). 12 refs, 3 figs.

45558 (INIS-SU–104/A, pp. 40) **Radiation-induced explosive distruction of polymethylmethacrylate under cooling. Model.** Smolyanskij, A.S. (Nauchno-Issledovatel'skij Fiziko-Khimicheskij Inst., Moscow (USSR)); Zhdanov, G.S. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

45559 (KCP–613-4113) **Isothermal reacting comparison of DGEBA [diglycidyl ether of bisphenol A]-type epoxy resins.** Spieker, D.A.; Larsen, F.N. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. (CONF-8909169–1: 18. North American Thermal Analysis Society conference, 24-27 Sep 1989). Order Number DE89015749/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The trend toward miniaturization of electronic components has prompted the need for materials with improved dielectric properties and decreased tendency to promote corrosion resulting from low levels of ionic impurities. Epoxy resins based on the diglycidyl ether of bisphenol A (DGEBA), which have reduced levels of total, ionic,

and/or saponifiable chlorine, have recently been introduced commercially for use in microelectronic applications. These electronic-grade resins have been either manufactured specifically to reduce, or purified to remove, the molecular species that are responsible for the ionic and saponifiable chlorine. Because some of these species have been shown to affect the bulk resin processing parameters, a study was undertaken to compare the reactivities of some electronic-grade resins to the non-electronic-grade materials. This paper presents the results of the DSC kinetic study performed on commercially available DGEBA resins to determine if process changes were required to replace a traditional DGEBA-type resin with a reduced chlorine version. 2 refs., 5 figs., 2 tabs.

45560 (LA-UR-89-1127) **Mechanical properties, solubilities, and processabilities in the design of the first super-strong liquid-crystalline polymers.** Dowell, F. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890902-1: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89009252/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Solidified super-strong (SS) liquid-crystalline polymers (LCPs) are designed to be the first polymers to have good compressive strengths, as well as to have tensile strengths and tensile moduli significantly greater than existing strong LCPs (i.e., backbone LCPs, such as Kevlar). These SS LCPs have also been designed with certain features to give good solubilities and processabilities. This paper covers the enhanced mechanical properties, solubilities and processabilities of the super-strong liquid crystal polymers. 16 refs., 1 fig., 1 tab.

45561 (N-89-22684) **The isothermal fatigue behavior of a unidirectional SiC/Ti composite and the Ti alloy matrix.** Gayda, J. Jr.; Gabb, T.P.; Freed, A.D. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. 36p. (NASA-TM-101984;E-4683;NAS-1.15:101984). Available from NTIS, PC A03/MF A01.

The high temperature fatigue behavior of a metal matrix composite (MMC) consisting of Ti-15V-3Cr-3Al-3Sn (Ti-15-3) matrix reinforced by 33 vol percent of continuous unidirectional SiC fibers was experimentally and analytically evaluated. Isothermal MMC fatigue tests with constant amplitude loading parallel to the fiber direction were performed at 300 and 550 C. Comparative fatigue tests of the Ti-15-3 matrix alloy were also conducted. Composite fatigue behavior and the in-situ stress state of the fiber and matrix were analyzed with a micromechanical model, the Concentric Cylinder Model (CCM). The cyclic stress-strain response of the composite was stable at 300 C. However, an increase in cyclic mean strain foreshortened MMC fatigue life at high strain ranges at 550 C. Fatigue tests of the matrix alloy and CCM analyses indicated this response was associated with stress relaxation of the matrix in the composite.

45562 (N-89-23302) **Evaluation, development, and characterization of superconducting materials for space application. Semiannual progress report No. 2.** Thorpe, A.N. Howard Univ., Washington, DC (USA). Jan 1989. 54p. (NASA-CR-184842;NAS-1.26:184842). Available from NTIS, PC A04/MF A01.

Results are reported of low magnetic field studies of dc magnetic susceptibility and ac magnetic susceptibility of bulk samples and powders. These data are analyzed and compared with the microstructures and compositions of the samples as determined by scanning electron microscopic micrographs, X-ray and chemical analysis. Particular emphasis is given to the interpretation of the ac magnetic susceptibility data which were obtained as function of the magnitude and frequency of the ac measuring field, and low values of an applied dc magnetic field. Two general conclusions are given and briefly discussed.

45563 (N-89-23400) **Effects of cosmic rays on single event upsets. Status report.** Venable, D.D.; Zajic, V.; Lowe, C.W.; Olidapupo, A.; Fogarty, T.N. Hampton Inst., VA (USA). Feb 1989. 84p. (NASA-CR-184835;NAS-1.26:184835). Available from NTIS, PC A05/MF A01.

Assistance was provided to the Brookhaven Single Event Upset (SEU) Test Facility. Computer codes were developed for fragmentation and secondary radiation affecting Very Large Scale Integration (VLSI) in space. A computer controlled CV (HP4192) test was developed for Terman analysis. Also developed were high speed parametric tests which are independent of operator judgment and a charge pumping technique for measurement of D(sub it) (E). The X-ray secondary effects, and parametric degradation as a function of dose rate were simulated. The SPICE simulation of static RAMs with various resistor filters was tested.

45564 (NRCC/IMR-29453) **Thermoanalytical characterization (DTA and TGA) of $RBa_2Cu_3O_{7-x}$ (R = Y, Gd, Nd) superconductors.** Noel, D.; Parent, L. National Research Council of Canada, Boucherville, PQ (Canada). Industrial Materials Research Inst. [1989]. 22p. (MICROLOG-89-03249). Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Differential thermal analysis (DTA) and thermogravimetric analysis (TGA) have been used to characterize $RBa_2Cu_3O_{7-x}$ (R = Y, Gd, Nd) superconductors. Even if the resistivity temperature curves are similar for the three compounds, DTA shows that the behavior of these materials during synthesis and sintering is different. Among the three systems, the Nd-Ba-Cu-O system is the most favorable to the formation of the 123 superconductor because secondary phases are present in smaller quantities. TGA curves suggest the presence of a transition from the orthorhombic phase to the tetragonal phase in nitrogen atmosphere at about 550-600^{0}C for the three perovskites. It was also found that the energy required to insert oxygen atoms in the crystal structure is smaller for Nd and Gd compounds than for the Y compound (Gd < Nd < Y). There is also a proportional relation between the ionic radius of the rare earth element and the onset melting temperature. 15 refs., 9 figs.

45565 (PB-89-856249/XAB) **Polymer radiation curing: epoxies, phenolics, fluorocarbons, and silicones. January 1970-February 1989 (Citations from the NTIS data base). Report for January 1970-February 1989.** National Technical Information Service, Springfield, VA (USA). Feb 1989. 182p. Available from NTISPC N01/MF N01.

Supersedes PB-88-857248.

This bibliography contains citations concerning the processes and effects of radiation curing on the following polymers: epoxy resins, phenolics, fluorocarbons and silicones. Gamma, ultraviolet, and infrared radiation are emphasized; however, polymer crosslinking by such electromagnetic wave radiation as microwave, laser, vacuum irradiation and ionization is included. Influence of radiation-induced polymer curing on mechanical, electrical, and chemical properties of the polymers is also included. (This updated bibliography contains 303 citations, 13 of which are new entries to the previous edition.)

45566 (SAND-89-0545C) **Mechanical states in wound capacitors: Part 2, Optimization.** Allen, J.J.; Reuter, R.C. Jr. Sandia National Labs., Albuquerque, NM (USA). 1989. 32p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890987-2: ASME design conference, 17-20 Sep 1989). Order Number DE89008116/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The winding process is encountered frequently in manufacturing, such as winding of polymer films and paper, laminated pressure vessel construction, and the manufacture of wound capacitors. The winding of capacitors will typically involve hundreds of plies of conductor and dielectric wound over a core. Due to the large number of layers, the calculation of the mechanical studies within a wound capacitor is a significant computational task. The focus of Part II of this paper is the formulation and application of optimization techniques for the design of wound capacitors. The design criteria to be achieved is a specified uniform wound tension in a capacitor. The paper will formulate an optimization statement of the wound capacitor design problem, develop a technique for reducing the numerical calculation required to repeatedly analyze the capacitor as required by the optimization algorithm, and apply the technique to an example. 4 refs., 13 figs., 4 tabs.

45567 (SAND-89-0848C) **Irreversible phase transition and wave propagation in silicate geologic materials.** Swegle, J.W.

Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–9: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016031/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Shock and unloading experiments on quartz and silicate rocks indicate the release adiabats lie below the Hugoniot. The hysteresis and energy dissipation inherent in this situation have important wave propagation implications. On loading, there is pressure-induced transition to the stishovite phase which is not abrupt, with the Hugoniot passing through a metastable mixed phase region for several tens of GPa. One interpretation of the unloading data is that the transition is not reversible, and the material remains in a frozen phase mixture on initial unloading. However, material strength may also play a role. A complete thermodynamically consistent EOS which includes phase transitions and strength effects has been developed and used to examine shock and release data on quartz and silicate rocks in order to quantify the kinetics of the reverse transition and to separate the hysteretic effects due to phase transition kinetics from those due to material strength. The model allows quantitative determination of the effect of transition kinetics on ground shock propagation in silicate materials. 7 refs., 6 figs.

45568 (SAND–89-0967C) **Hugoniot and release properties of a water-saturated high-silica-content grout.** Grady, D.E.; Furnish, M.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–16: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016876/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Shock and release wave experiments have been performed on a water- saturated grout using a two-stage light-gas launcher and laser velocity interferometry. In this work maximum Hugoniot pressures approaching 70 GPa were achieved. A novel experimental method, in which the sample being tested is mounted in the launcher projectile, was developed during the study which provided both good quality Hugoniot data and release data on thin specimens of the material. Analysis methods were developed to determine pressure-volume unloading paths from the release wave data. The data are considered in terms of nonhydrodynamic and/or nonequilibrium thermodynamic behavior within the shock compression process. 5 refs., 6 figs.

45569 (SAND–89-1022C) **Behaviour of VF_2/VF_3 piezoelectric copolymers under shock loading.** Bauer, F.; Graham, R.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–19: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016538/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

Vinylidene fluoride and trifluoroethylene (VF_2/VF_3) copolymers are known to be of ferroelectric nature. Their piezoelectric properties are strong dependent on the polarization process as well as on the value of the remanent polarization. VF_2/VF_3 films of 55 microns in thickness have been pressed at ISL. The polarization process is based on that used for the homopolymer PVDF. Reproducible values of remanent polarization of 8 $\mu C/cm^2$ were obtained for VF_2/VF_3 copolymers with 70% of VF_2 in a shock gauge configuration. Properties of these copolymers are presented. First results of the piezoelectric response of VF_2/VF_3 shock gauges under shock loading are presented over the range 0-16 Gpa. They show that the response of the copolymers is a continuous function of the shock pressure. The results ore discussed. 10 refs., 6 figs., 2 tabs.

45570 (SAND–89-2013C) **The effects of pressure on the β molecular relaxation process in polyvinylidene fluoride.** Samara, G.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–17: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016883/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The hydrostatic pressure dependence of the β molecular relaxation process of polyvinylidene fluoride (PVDF) has been investigated to 20 kbar. This relaxation is known to have a strong influence on the electrical and mechanical properties of PVDF. The observed large slowing down of the relaxation process is discussed in terms of the Vogel–Fulcher equation. There is an increase in both the energy barrier to dipolar motion and the reference temperature (T_0) for the kinetic relaxation process which represents the "static" dipolar freezing temperature for the process.

45571 (UCID–21742) **X-ray diffraction patterns of metal aurocyanides.** Selig, W.S.; Smith, G.S.; Harding, K.K.; Summers, L.J. Lawrence Livermore National Lab., CA (USA). Jun 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015188/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Aurocyanides of the following metal cations have been prepared: Ag, Hg(II), Ga, Fe(III), Tl(I), Bi, Pb, Mn(II), Ni, Zn, Cu(II), Cd, In, and Co(II). Most of the aurocyanides are of the type $M[Au(CN)_2]_x$ where M is the metal cation and x its valence. However, under some conditions mixed aurocyanides containing K may be formed, such as $KCo[Au(CN)_2]_3$. Only Ag and Hg(II) form aurocyanides which are sufficiently insoluble for the potentiometric determination of the aurocyanide anion. The diffraction patterns of the various aurocyanides are reported. 12 refs., 16 tabs.

45572 (UCRL–100647) **The response of isotropic brittle materials to abrasive processes.** Brown, N.J.; Fuchs, B.A.; Hed, P.P.; Stowers, I.F. Lawrence Livermore National Lab., CA (USA). 24 Apr 1989. 7p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. AFWL-88-162. (CONF-8904259–1: American Society for Precision Engineering spring conference, 25-27 Apr 1989). Order Number DE89016637/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper is an overview of brittle material responses to abrasion. It proposes a 3 region model for both 2-body and 3-body wear, two regions being where removal rate is nearly independent of abrasive size at otherwise identical conditions and a transition region where rate is proportional to abrasive size. The mechanics will be explored through these 3 regions in 2-body and 3-body wear and some comparisons will be made to the wear of nonbrittle materials. 14 refs.

45573 (UCRL–100650) **Shear mode grinding.** Brown, N.J.; Fuchs, B.A. Lawrence Livermore National Lab., CA (USA). 24 Apr 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8904263–1: American Physical Society spring conference, 24-27 Apr 1989). Order Number DE89015779/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The thesis of this paper is that shear mode grinding of glass (1) occurs with abrasive particle sizes less than 1 μm, (2) that it is the mechanical limit of the the more common mechanical-chemical glass polishing, and (3) that the debris is insufficient in size to perform the function of eroding the binder in the grinding wheel and thus necessitates the addition of an abrasive and/or chemical additions to the coolant to effect wheel-dressing. 13 refs.

45574 Formation of a quasicrystalline phase from the glassy state in Pd-U-Si. Drehman, A.J. (Ames Lab.-USDOE, Iowa State Univ., Ames, IA (US)); Poon, S.J.; Lawless, K.R. vp. of Rapidly solidified alloys and their mechanical and magnetic properties. Giessen, B.C.; Polk, D.E.; Taub, A.I. Materials Research Society, Pittsburgh, PA (1986). (CONF-851217–: Materials Research Society meeting, 2-7 Dec 1985).

Metallic glasses of composition $Pd_{58.8}U_{20.6}Si_{20.6}$ can be transformed to a metastable single phase with quasicrystalline order by thermal annealing. The icosahedral symmetry of this phase was verified by both electron and x-ray diffraction. Although the metallic glass can be formed over a broad compositional range the homogeneity range of this icosahedral phase is less than 1%. This indicates strong chemical ordering in the quasicrystalline state.

45575 Experimental evaluation of an equation applicable for surface cracks under tensile or bending loads. Reuter, W.G. (Idaho National Lab., EG and G Idaho, Inc., Idaho Falls, ID (US)); Epstein, J.S. pp. 939 of Fracture mechanics. Cruse, T.A. ASTM,

Philadelphia, PA (1988). (CONF-860675–: 19. national symposium on fracture mechanics (ASTM), 30 Jun - 2 jul 1986).

If a structural material behaves in a linear elastic manner, it is generally assumed that plane-strain fracture toughness (K_{Ic}) may be used with applicable solutions to predict conditions for catastrophic fracture. There have been a few instances where the adequacy of this approach has been verified, but these evaluations were conducted for specific applications. This paper evaluates an approach using specimens containing surface cracks, with substantial variations in crack size and shape, and loaded by either tension or bending. Test results are used to compare the critical stress-intensity factor (K_{crit}) with K_{Ic}. Moire interferometry is used to obtain K_I at the free surface for comparison with the calculated result.

45576 Theoretical description of the graphite, diamond, and liquid phases of carbon. van Thiel, M. (Lawrence Livermore National Lab., CA (USA)); Ree, F.H. *International Journal of Thermophysics (USA),* 10(1): 227-236 (Jan 1989). DOE Contract W-7405-ENG-48. (CONF-880606–: 10. symposium on thermophysical properties, 20-23 Jun 1988).

A three-phase equation-of-state model, to be used in high-pressure high-density simulations of systems containing carbon, is described for the system graphite-diamond-liquid. The solid phases are represented by cold lattice and thermal energy terms. Simple additivity of the energy terms is assumed and the cold curve is a modified Birch form. Liquid states for diamond and graphite are obtained by a previously described scaling model. The actual Gibbs free energy of the liquid state uses the free energy of these liquids in a mixture model that includes an entropy of mixing and a pressure-dependent strain term. It is noted that the thermal expansion coefficient and the Grueneisen gamma increase faster above 3,000 K than the usual approximation for the volume dependence would predict. The result is a phase diagram that fits all available data.

45577 Synthesis, ESR studies, band electronic structure, and superconductivity in the $(BEDT\text{-}TTF)_2M(NCS)_2$ system (M = Cu, Ag, Au). Carlson, K.D. (Argonne National Lab., IL (USA)); Geiser, U.; Kini, A.M.; Wang, H.H.; Montgomery, L.K.; Kwok, W.K.; Beno, M.A.; Williams, J.M.; Cariss, C.S.; Crabtree, G.W.; Whangbo, M.H. *Inorganic Chemistry (USA),* 27(6): 967-969 (23 Mar 1988).

In order to further expand the bank of information concerning the superconducting transition temperatures of organic systems based on ET systems (ET = bis(ethylenedithio)tetrathiafulvalene), a comprehensive study of the electrocrystallization of $k\text{-}(ET)_2Cu(NCS)_2$ was carried out. Results of the first electron spin resonance studies that allow one to distinguish between superconducting and non-superconducting phases are reported. The electronic band structure for the compound was calculated, and the superconducting state at near 10 K was verified. Electrocrystallization and properties of new compounds $Ag(SCN)_2^-$ and $Au(SCN)_2^-$ salts of ET are briefly discussed. 19 refs., 2 figs., 1 tab.

45578 Surface rotational phonons on the cleavage faces of tetrahedrally coordinated compound semiconductors. Duke, C. B. (Pacific Northwest Laboratory, Richland, Washington 99352(US)); Wang, Y. R. *Journal of Vacuum Science and Technology, B: Microelectronics Processing and Phenomena (USA),* 7(4): 1027-1030 (Jul 1989). DOE Contract AC06-76RL01830.

Surface rotational phonons associated with atomic displacements about the relaxed minimum-energy surface geometry are shown to be responsible for a new branch in the surface excitation spectra of GaAs(110) observed via inelastic helium atom scattering. These phonons are associated with the rehybridization-induced surface reconstructions on the cleavage surfaces of both zincblende and wurtzite structure compound semiconductors. For zincblende structure materials, the frequencies of these phonons are predicted for the (110) surfaces of GaP, GaAs, GaSb, InP, InAs, InSb, ZnS, ZnSe, and CdTe. For wurtzite structure materials, the frequencies are predicted for the $(10\bar{1}0)$ surfaces of ZnO, ZnS, ZnSe, CdS, and CdSe. A discussion is given on the role of tetrahedral symmetry in determining the nature and consequences of these phonons.

45579 Numerical simulation of dynamic consolidation of a SiC fiber-reinforced aluminum composite. Williamson, R. L. (Idaho National Engineering Laboratory, EG&G Idaho, Inc., P.O. Box 1625, Idaho Falls, Idaho 83415(US)); Wright, R. N.; Korth, G. E.; Rabin, B. H. *Journal of Applied Physics (USA),* 66(4): 1826-1831 (15 Aug 1989). DOE Contract AC07-76ID01570.

Dynamic consolidation of a SiC fiber-reinforced aluminum matrix composite resulting from the stress wave generated by an impacting stainless-steel plate has been simulated using a two-dimensional numerical model in which the aluminum and SiC are assumed to be infinite cylinders prior to consolidation. Impact velocities of 0.5, 0.75, and 1.0 km/s were considered in the simulations. For impact plate velocities greater than 0.5 km/s, bonding is predicted to occur between the aluminum cylinders by melting in the regions of greatest plastic flow. In the interstices that are filled by a SiC fiber there is less plastic flow and the maximum temperature is significantly reduced. Results of the simulation are compared with the microstructure of a composite formed using a stainless-steel impact plate with a velocity of 0.7 km/s to consolidate a close-packed array of aluminum wires which contained SiC fibers of the appropriate diameter to fill the interstices to approximate the geometry of the model. The predictions of the simulation with respect to the observed deformation and the location and extent of melting of the aluminum wires are in good agreement with the experiment.

45580 Measurements of carbon thin films using x-ray reflectivity. Toney, M. F. (IBM Almaden Research Center, IBM Research Division, San Jose, California 95120(US)); Brennan, S. *Journal of Applied Physics (USA),* 66(4): 1861-1863 (15 Aug 1989). DOE Contract AC03-82ER13000.

We report x-ray reflectivity measurements on ultrathin (~250 A) amorphous carbon films and show that for film thicknesses of a few hundred angstroms this is an extremely effective, accurate, and nondestructive technique for measuring the thickness, density, and microscopic surface roughness. These properties are difficult to accurately measure using other methods. However, since they affect the functional performance of these films and are dependent on preparation conditions, their determination is particularly important.

45581 Synthetic laser medium. Stokowski, S.E. To Dept. of Energy, Washington, DC. USA Patent 4,824,598. 25 Apr 1989. Filed date 20 Oct 1987. 5p. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A laser medium is particularly useful in high average power solid state lasers. The laser medium includes a chromium dopant and preferably neodymium ions as codopant, and is primarily a gadolinium scandium gallium garnet, or an analog thereof. Divalent cations inhibit spiral morphology as large boules from which the laser medium is derived are grown, and a source of ions convertible between a trivalent state and a tetravalent state at a low ionization energy are in the laser medium to reduce an absorption coefficient at about one micron wavelength otherwise caused by the divalent cations. These divalent cations and convertible ions are dispersed in the laser medium. Preferred convertible ions are provided from titanium or cerium sources.

40 CHEMISTRY

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Refer also to citation(s) 44590, 44623, 44634, 44647, 44648, 44650, 44652, 44679, 44680, 45400, 45507, 45556, 45574, 45692, 45693, 46011, 46074, 46107, 46359

45582 (AD-A–208216/2/XAB) **Intercalation reactions of the neptunyl(vi) dication with hydrogen uranyl phosphate and hydrogen neptunyl phosphate host lattices. Technical report.** Dorhout, P.K.; Kissane, R.J.; Abney, K.D.; Avens, L.R.; Eller, G. Wisconsin Univ., Madison, WI (USA). Dept. of Chemistry. 17 May 1989. 28p. (UWIS/DC/TR–89/5). Available from NTIS, PC A03/MF A01.

The hydrated layered solids, hydrogen uranyl phosphate. HUO_2PO_4, HUP, and its isostructural neptunyl analog, $HNpO_2PO_4$, HNPP, can be intercalated with $UO_2(2+)$ and $NPO_2(2+)$ ions to yield a family of layered, hydrated solids that have been characterized by X-ray powder diffraction and by infrared, Raman, and electronic spectroscopy. Aqueous reactions of HUP with $UO_2(2+)$ and of HNPP with $NPO_2(2+)$ lead to hydrated layered solids,

$(UO_2)3(PO_4)_2$, UP, and $(NPO_2)_3(PO_4)_2$, NPP; preparation of UP from HUP and of NPP from HNPP can also be effected by thermal decomposition of the parent solids, thus affording a set of self intercalation reactions that are reversible. Cross-intercalation reactions $(UO_2(2+)$ into HNPP; $NPO_2(2+)$ into HUP) also proceed under stoichiometric conditions.

45583 (AD-A–208217/0/XAB) **Structural, optical, and redox properties of lamellar solids derived from copper(1) complexes and n-butylammonium uranyl phosphate and arsenate. Technical report.** Jacob, A.T.; Ellis, A.B. Wisconsin Univ., Madison, WI (USA). Dept. of Chemistry. 12 May 1989. 40p. (UWIS/DC/TR–89/4). Available from NTIS, PC A03/MF A01.

A family of hydrated, layered solids was prepared from intercalative ion-exchange reactions of n-butylammonium uranyl phosphate (BAUP) or arsenate (BAUAs), $(n\text{-}C_4H_9NH_3)$-$UO_2EO4.3H_2O$ (E = P, As), with Cu(LL)2+ complexes (LL is dmp = 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline; or bcp = 2,9-dimethyl1-1,10-phenanthroline). The products obtained were analyzed as having compositions (Cu(LL)2)x(BA)1-xU02E04.2H20 with x approx.0.2. Xray powder diffraction data reveal that the compounds are single phases that can be indexed on the basis of a tetragonal unit cell. The solids exhibit absorption and photoluminescence (PL) properties characteristic of the Cu(LL)2+species; the Cu(I) complexes completely quench the uranyl PL. Once intercalated, the Cu(I) complexes can be oxidized using Br2 vapor and re-reduced either photochemically or by N2H4 vapor, as shown by changes in electronic and EPR spectra.

45584 (CONF-881054–Vol.1, pp. 105-116) **Cathodic stripping technique for the determination of trace levels of arsenic and selenium in waste, organic, and environmental samples.** Powell, M.R. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

This paper describes a sensitive, accurate method based on electrochemical cathodic stripping to determine trace levels of arsenic and selenium. The determination of trace levels of arsenic and selenium has been of growing concern due to the toxicity and widespread occurrence of these elements in the environment. Recently, there has been a great interest in electrochemical stripping techniques as methods of analysis for these elements because of the inherent sensitivity and ease of analysis. The primary advantage of this techniques is the ability to preconcentrate the elements at the mercury electrode as mercury complexes. These compounds can then be stripped back into the supporting electrolyte of HC1 with the resulting current proportional to the concentration. A PARC model 384B polarographic analyzer with multiple 303A static drop mercury electrodes was used to analyze samples with detection limits of 0.005 mg/L for both arsenic and selenium. The primary obstacle to the use of high sensitivity voltammetric analysis has been high background currents caused by the presence of electroactive substances in the sample matrix. In order to eliminate this problem, sample preparations consist of a perchloric/nitric acid digestion for aqueous samples, or oxygen bomb digestion for organic samples. These techniques have proven satisfactory for most samples and result in a sample matrix that is satisfactory for voltammetric analysis. An anion/cation ion exchange technique has been developed to eliminate background problems. In addition, the ion exchange eliminates direct interference from metals such as copper, lead, and tin.

45585 (CONF-881054–Vol.1, pp. 129-139) **Solvent extraction technique for the analysis of thorium-230 using the Photon-Electron Rejecting Alpha Liquid Scintillation Spectrometer (PERALS).** Doane, R.W. (TMA/Eberline, Oak Ridge, TN (USA)); McDougall, M.R. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

A solvent extraction technique has been developed to improve the analysis and recoveries for Thorium-230. The emphasis of this technique is to improve productivity and precision over ion-exchange when using the Photon-Electron Rejecting Alpha Liquid Scintillation Spectrometer (PERALS). The Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (FUSRAP) currently is involved in characterizing sites that are contaminated with alpha emitting radionuclides which can not be detected with field instrumentation. This technique and equipment demonstrates the ability to be used for in-the-field analysis for all alpha emitting radionuclides with only minor modifications of in-laboratory procedures. The PERALS system offers 99.7% detection capability which greatly reduces counting times previously required for low activity samples. The solvent extraction technique coupled with the PERALS system significantly increases sample productivity and decreases unit cost per analysis. A description of the solvent extraction technique, the analytical instrumentation, and typical applications are discussed.

45586 (CONF-8909172–1) **Multiphoton resonant ionization.** Christie, W.H.; Fassett, J.D. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From SIMS VII: 7th international conference on secondary ion mass spectrometry; 3-8 Sep 1989. Order Number DE89015978/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

RESONANCE IONIZATION MASS SPECTROSCOPY; IONIZATION; ATOMIZATION; MASS SPECTROMETERS; LASERS; COMPARATIVE EVALUATIONS

45587 (EGG-SSRE–8506) **INEL Contract Compliance Screening Program technical documentation: Volume 1.** Shea, J.P.; Van Haaften, D.H. EG and G Idaho, Inc., Idaho Falls, ID (USA). May 1989. 73p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016209/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The Contract Compliance Screening (CCS) Program is part of a dBASE III Plus data management system developed by the Idaho National Engineering Laboratory (INEL) to manage chemical analysis data generated during environmental monitoring programs. This document describes the automated version of the CCS procedures for chemical data produced under the Environmental Protection Agency (EPA) Contract Laboratory Program (CLP) according to the 7/87 Statement of Work for Inorganics, and the 10/86 Statement of Work for Organics. The CCS program was developed to provide a fast, efficient means of screening the quality of chemical analysis of samples according to the CLP and the EPA's CCS procedures. The CCS program provides a preliminary assessment of the accuracy and completeness of the data package. The output highlights data package deficiencies and serves as a filter and focusing mechanism for subsequent comprehensive data package quality assessment.

45588 (EPRI-EL–6416) **The evaluation of PCDF [polychlorinated dibenzofuran] analytical methodologies: Final report.** DeRoos, F.L. Electric Power Research Inst., Palo Alto, CA (USA); Twin City Testing Corp., St. Paul, MN (USA). c Aug 1989. 59p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

The objective of this program was to review five analytical methods used for the determination of PCDDs and PCDFs in utility fluids and to subsequently develop a combined, optimized analytical method. The analyte enrichment efficiency of the component steps of each method were evaluated separately by comparing their matrix removal efficiencies. The most efficient component steps were then recombined to produce the optimized method. The optimized method was evaluated by analyzing two in-service utility fluids. One fluid was an Askarel oil and the other a mineral oil. Each of the fluids was analyzed in triplicate by capillary column gas chromatography/low resolution mass spectrometry, as received and after spiking with known levels of selected PCDD and PCDF isomers. As a further evaluation of the method, each of the extracts was also analyzed by high resolution mass spectrometry. The optimized method worked well for both utility fluid matrices with the low and high resolution techniques providing similar precisions and accuracies. The precisions of the determination were typically better than 8%, while the accuracies of the spiked isomer determinations were in the range of 70–120%. 26 tabs.

45589 (IAEA-SAR–5) **Error analysis of isotope dilution mass spectrometry method with internal standard.** Rizhinskii, M.W.; Vitinskii, M.Y. International Atomic Energy Agency, Vienna (Austria). Dept of Safeguards. Feb 1989. 54p. Order Number DE89635998/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Translated from Russian. Prepared under Task SU-3-2 of the IAEA/USSR Technical Support Programme.

The computation algorithms of the normalized isotopic ratios and element concentration by isotope dilution mass spectrometry with internal standard are presented. A procedure based on the Monte-Carlo calculation is proposed for predicting the magnitude of the errors to be expected. The estimation of systematic and random errors is carried out in the case of the certification of uranium and plutonium reference materials as well as for the use of those reference materials in the analysis of irradiated nuclear fuels. 4 refs, 11 figs, 2 tabs.

45590 (IAEA-TECDOC–512) **Analytical chemistry in semiconductor manufacturing: Techniques, role of nuclear methods and need for quality control. Report of a consultants' meeting on the need for intercomparison and reference materials for characterization of silicon held in Gaithersburg, Maryland, USA, 2-3 October 1987.** International Atomic Energy Agency, Vienna (Austria). Jun 1989. 45p. (CONF-8710491–: Consultants' meeting on the need for intercomparison and reference materials for characterization of silicon, 2-3 Oct 1987). Order Number DE89634686/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This report is the result of a consultants meeting held in Gaithersburg, USA, 2-3 October 1987. The meeting was hosted by the National Bureau of Standards and Technology, and it was attended by 18 participants from Denmark, Finland, India, Japan, Norway, People's Republic of China and the USA. The purpose of the meeting was to assess the present status of analytical chemistry in semiconductor manufacturing, the role of nuclear analytical methods and the need for internationally organized quality control of the chemical analysis. The report contains the three presentations in full and a summary report of the discussions. Thus, it gives an overview of the need of analytical chemistry in manufacturing of silicon based devices, the use of nuclear analytical methods, and discusses the need for quality control. Refs, figs and tabs.

45591 (IAEA-TECDOC–512, pp. 35-37) **Analytical standards and silicon analysis.** Lindstrom, R.M. (National Bureau of Standards, Gaithersburg, MD (USA)). International Atomic Energy Agency, Vienna (Austria). Jun 1989. (CONF-8710491–: Consultants' meeting on the need for intercomparison and reference materials for characterization of silicon, 2-3 Oct 1987). In *Analytical chemistry in semiconductor manufacturing: Techniques, role of nuclear methods and need for quality control. Report of a consultants' meeting on the need for intercomparison and reference materials for characterization of silicon held in Gaithersburg, Maryland, USA, 2-3 October 1987.* Order Number DE89634686/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The quality of silicon and other electronic materials needs to be carefully controlled by appropriated method of chemical analysis. Sufficiently sensitive analytical techniques as well as suitable certified reference materials are, however, lacking to the analytical community. It is argued that semiconductor grade polycrystalline silicon can be a useful standard material because of its high purity. (author). 4 refs.

45592 (IAEA-TECDOC–512, pp. 21-33) **Techniques for the characterization of trace impurities in silicon.** Shaffner, T.J. (Texas Instruments, Inc., Dallas, TX (USA)). International Atomic Energy Agency, Vienna (Austria). Jun 1989. (CONF-8710491–: Consultants' meeting on the need for intercomparison and reference materials for characterization of silicon, 2-3 Oct 1987). In *Analytical chemistry in semiconductor manufacturing: Techniques, role of nuclear methods and need for quality control. Report of a consultants' meeting on the need for intercomparison and reference materials for characterization of silicon held in Gaithersburg, Maryland, USA, 2-3 October 1987.* Order Number DE89634686/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Recent advances in microelectronics can be measured by our evolving ability to measure low levels of impurities and dopants in bulk silicon material, thin metal and oxide layer overcoats, and fabricated devices. A variety of techniques are available which rely on probes of electrons, ions, and light to measure ppma-ppba levels of single element and electrically active species in silicon. Each has its strength and weakness with regard to the inevitable compromise between point-to-point x-y spatial resolution, depth resolution, and detectability (signal-to-noise). Modern applied methods include secondary ion mass spectroscopy (SIMS), neutron activation analysis (NAA), photoluminescence spectroscopy (PL), and glow discharge mass spectroscopy (GDMS). Promising new technologies are emerging which are capable of ppta and sub-ppta performance. One example is laser resonance ionization spectroscopy (RIS) which relies on post ionization of sputter liberated neutral particles to achieve both ppta sensitivity and 20A depth profiling. Other breakthroughs have resulted from the synergism of combining separate technologies. Fourier transform photoluminescence (FTPL) and accelerator based mass spectroscopy (SuperSIMS) will be discussed in this context. Some fundamental constraints of sampling and signal-to-noise are also pointed out which impose ultimate limits to our progress in increasing sensitivity to trace elements. (author). 27 refs, 5 figs, 2 tabs.

45593 (IAEA-TECDOC–512, pp. 39-44) **Summary of presentations and discussions with special reference to the need of intercomparison and reference materials in analytical chemistry related to silicon electronics.** Shaffner, T.J. (Texas Instruments, Inc., Dallas, TX (USA)); Lindstrom, R.M. International Atomic Energy Agency, Vienna (Austria). Jun 1989. (CONF-8710491–: Consultants' meeting on the need for intercomparison and reference materials for characterization of silicon, 2-3 Oct 1987). In *Analytical chemistry in semiconductor manufacturing: Techniques, role of nuclear methods and need for quality control. Report of a consultants' meeting on the need for intercomparison and reference materials for characterization of silicon held in Gaithersburg, Maryland, USA, 2-3 October 1987.* Order Number DE89634686/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It would be desirable to have available a standard silicon, characterized for composition. There are many technical questions regarding the actual production of this material. These include how to produce a relatively homogeneous quantity of silicon, and what physical form (wafers, crushed pieces, or powder) is both most useful and easiest to produce without contamination. The production of such a material must be done and the characterization should be done in collaboration with silicon producers and with such national and international organizations as Semiconductor Equipment and Materials Institute (SEMI), ASTM, and Deutsche Industrie Norm (DIN). There are no readily available, widely distributed standards certified for content of the major dopants: B, P, As, and Sb. In view of the low concentrations and steep concentration gradients of transition metals in single-crystal material, the best choice of material may be semiconductor grade polycrystalline silicon. There is a need for standard materials for the calibration of oxygen in high purity silicon at the low ppm level. Standards presently exist, the JEIDA from Japan having gained the most credibility during the past decade. Availability of these standards has been restricted, and as the need for calibration between vendors of silicon materials increases, their value has increased.

45594 (IC–89/82) **Nigerian coal analysis by PIXE and HEBS techniques.** Olabanji, S.O. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 17p. Order Number DE89635999/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

PIXE and HEBS techniques were employed for the measurement of the concentrations of the major, minor and trace elements in Nigerian coal samples from a major deposit. The samples were irradiated with 2.55 MeV protons from the 3 MeV tandem accelerator (NEC 3 UDH) in Lund. The PIXE results are reported and compared with an earlier work on Nigerian coal using FNAA and INAA analytical techniques while the HEBS results are compared with ASTM previous results. The results corroborate the assertion that Nigerian coals are of weak and noncoking grades with low sulphur (0.82-0.99%) and relatively high hydrogen (4.49-5.16%) contents. The motivation for this work is partly due to the projected usage of coal as metallurgical feedstocks and as fuel, and partly because of the genuine concern about the concomitant environmental effects of the increased burning of coal. The knowledge of the concentration of all elements is important for the characterization of coal and the determination and control of its products. Economic parameters such as

the ash contents and calorific values are associated with the concentrations of coal's constituents. (author). 11 refs, 1 fig., 4 tabs.

45595 (IC–89/83) **PIXE analysis of museum soapstone sculptures from Esie, south west Nigeria.** Olabanji, S.O.; Olarewaju, V.O.; Onabajo, O. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 20p. Order Number DE89636000/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The PIXE technique was employed for the study of Esie museum stone sculptures using 2.55 MeV protons from the 3 MeV tandem accelerator (NEC 3 UDH) in Lund, coupled with the geological and archaeological findings. The aim is to elucidate and decipher the prodigious but rather enigmatic and bewildering stone sculptures. PIXE results show that the composition of the stone sculptures are 40.69% talc-tremolite schist, 30.88% talc-chlorite schist, 15.20% talc-tremolite-anthophyllite schist and 13.24% talc-amphibolite schist. Thus the composition of Esie sculptures are found to be the same with the locally available talc-schists present around Esie. The geological evidence (mineralogical results) corroborated this as there was no textural or mineralogical difference between the talc-bearing country rock (outcrop) in Esie and the museum soapstone samples studied. Consequently, there is a very high probability that the sculptures were carved using the locally available talc-schists. (author). 7 refs, 4 figs, 2 tabs.

45596 (INIS-BR–1585) **Plasma emission spectroscopy (DCP) for rare earths determination in waters from Morro do Ferro (MG) Brazil, after chromatographic preconcentration.** Figueiredo, A.M.R. de. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Quimica. 24 Apr 1987. 211p. (In Portuguese). Order Number DE89636058/JAW. Available from NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS.

Rare earth determinations in surface and well waters from Morro do Ferro was studied using chemical preconcentration methods of the group and plasma emission spectroscopy excited by direct current are - DCP. A method that combines retention in alumina is HF medium with ion exchange for the preconcentration of the group was developed in semi micro scale. DCP determination, in the sequencial mode by using mixed standards containing, Y, La, Ce, Nd, Pr, Sm, Eu, Ga, Tb, Dy, Er, Yb and Al, principal concentrate componentes was studied by analysis of the profile of each spectral line. Principal cations, anions, ph and Eh were determined. Semi-micro techniques were developed for anions preconcentration and for determination of sulphate, phosphate and carbonate. (M.J.C.).

45597 (INIS-BR–1590) **Addition compounds of lanthanide trifluoromethanessulfonates (III) and yttrium (III) and N,N,N',N' tetramethyladipamide.** Machado, L.C. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1982. 125p. (In Portuguese). Order Number DE89636001/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The preparation of adducts from reaction between lanthanide trifluoromethanesulfonates and N,N,N',N'- tetramethyladipamide by the reaction of the hydrated salts with the ligand in acetone and microanalytical data of the lanthamides, carbon, hydrogen and nitrogen that indicate the existence of two series of compounds is shown. The addition compounds were characterized by infrared spectroscopy, x-ray diffraction (powder method), eletrolytic condutance in nitromethane and absorption spectroscopy for the neodymium and fluorescense of the europium compounds (at room temperature and at 77 K). (M.J.C.).

45598 (INIS-BR–1594) **Addiction compounds of lanthanide methanesulfonates and yttrium and N,N-dimethylacetamide.** Miotti, R.D. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1985. 83p. (In Portuguese). Order Number DE89636002/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The adducts obtained by mixing the hydrated lanthamide methanesulfonate with an excess of DMA, warmed in a water bath are studied. The resulting solution maintained under vaccum, over anhydrous calcium chloride, to evaporate the excess of the ligand and crystallize the compounds. The lanthanide content was determined by complexometric titration with EDTA. Carbon, nitrogen and hydrogen were determined by microanalytical procedure. X-ray powder patterns indicate the existence of four series of isomorphous substances: La-Nd; Sm, Eu; Gd-Dy; and Ho-Lu, Y. (M.J.C.).

45599 (INIS-mf–11504) **Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.** International Atomic Energy Agency, Vienna (Austria). 1988. 247p. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The purpose of this Co-ordinated Research Programme (CRP) is to obtain comparative data on the existing elemental concentrations of potentially toxic elements in foodstuffs in various countries. This study is also intended to provide information on the dietary intakes of toxic elements as a means to detect potential health hazards to the population groups concerned. This study has important economic implications since trade in foodstuffs is dependent on compliance with regulations pertaining to maximum permissible concentrations. An important supplementary purpose of the programme is to help establish analytical expertise for work of this kind in individual countries, allowing such laboratories to offer analytical quality control services. The programme has centred its objective on the determination of important toxic elements such as As, Cd, Cr, Hg, Pb and Se, in addition to Cu, Sb and Zn, which are also potentially toxic but are generally of minor importance from the point of view of public health. The matrices of interest are foodstuffs which comprise together more than 50% of the average daily intake. Drinking water is also of high importance and should be analysed as well. Refs, figs and tabs.

45600 (INIS-mf–11504, pp. 15-36) **Advances in the study of neutron activation analysis of toxic elements in meat and farinaceous foods of Argentina.** Resnizky, S.M. (Comision Nacional de Energia Atomica, Buenos Aires (Argentina). Direccion de Radioisotopos y Radiaciones); Bertini, L.M.; Moreno, M.A.; Piedracoba, N.V. de. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The features of a project for activation analysis for toxic elements in meat and farinaceous foods of Argentina were designed, and preparation of standards was described at the First Research Coordination Meeting on Nuclear Techniques for Toxic Elements in Foodstuffs in Bombay, India. At the present meeting methods of determination of As, Se, Sb, Hg and Cd developed in our laboratory during 1986 and 1987 as well as the results, of the three analytical quality control samples forwarded by the IAEA are reported. 7 refs, 4 figs, 10 tabs.

45601 (INIS-mf–11504, pp. 37-49) **Application of neutron activation analysis to the detrmination of toxic elements in Australian foodstuffs.** Fardy, J.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)); McOrist, G.D.; Farrar, Y.J.; Gorman, T.F.; Bowles, C.H.; Tan Mingguang. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Recent measurements in our laboratory have indicated that the average selenium content in the plasma of Australians is 0.09 mg L^{-1} which is significantly lower than that found in the inhabitants of most other Western countries with the exception of New Zealand. Research aimed at explaining these low levels had begun when an invitation was received from the IAEA to join a Coordinated Research Programme on Nuclear Techniques for Toxic Elements in Foodstuffs. The investigation was widened, therefore, to include other toxic elements, arsenic, mercury, zinc and antimony and the suite of trace elements determined by neutron activation analysis

(NAA) techniques. To complete the survey of toxic elements, the lead and cadmium of the chosen foodstuffs are being analysed by anodic stripping voltammetry (ASV) and soon will be examined by inductively coupled plasma mass spectrometry (ICPMS). Drinking water from a number of locations were sampled in cleaned, screw-top polystyrene containers, frozen and stored in a freezer until ready for analysis. 7 refs, 4 figs, 4 tabs.

45602 (INIS-mf–11504, pp. 51-62) **Application of neutron activation analysis to the monitoring of trace elements in Brazilian foodstuffs.** Vasconcellos, M.B.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)); Munita, C.J.S.; Maihara, V.A.; Abe, R.M. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The work of the group of the Radiochemistry Division on food analysis started with milk powder and bread samples, since these foodstuffs are largely consumed by the population of Sao Paulo (Brazil). Both instrumental and radiochemical NAA techniques were employed, allowing the determination of the elements Na, Cl, Mn, Br, Fe, Zn, Rb, Sb, Se, Cr, Al, Mg, Cu and La. Nuclear techniques for toxic elements in foodstuffs, were applied more specifically to the analysis of rice, specially for Hg and Se. A radiochemical separation procedure was developed for the determination of these two elements, at the ppb level, based on distillation and precipitation. INAA was applied to determine As, Br, Na, K, Rb and Zn, as well. 3 tabs.

45603 (INIS-mf–11504, pp. 63-80) **Determination and evaluation of toxic elements in Chinese foodstuffs.** Sun Laiyan (Chinese Academy of Agricultural Sciences, Beijing (China). Inst. for Application of Atomic Energy); Lu Fengying; Zhou Wenping; Zhen Houxi; Su Rongwei; Liao Qingshang; Li Xuezeng; Wang Huaihui. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The concentrations of toxic elements As, Br, Cr, Cu, Pb, Se and Zn in various foodstuffs collected in Beijing, Shanghai, Xian and Wuhan were determined using neutron activation analysis (NAA) and atomic absorption spectrometry (AAS) methods were obtained with high or medium precision. According to the average daily intake of various foods, the daily intake of these toxic elements were estimated for each person in the four cities. They (in microgram) were 42.6, 166.3, 1738, 106.8, 7939, 1145 and 67.1 respectively for As, Cr, Cu, Se, Zn, Br and Pb in Beijing, 52.2, 167, 1213, 91.5, 6026, 519 and 89.9 in Shanghai, 46.2, 184, 1782, 119.2, 8729, 1132 and 133.4 in Xian, and 63.2, 142.1, 1556, 76.9, 7882, 528 and 73.7 in Wuhan. (author). 2 refs, 12 tabs.

45604 (INIS-mf–11504, pp. 81-95) **Evaluation of analytical methods for the determination of toxic elements in foodstuffs.** Iyer, R.K. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.); Krishnamoorthy, K.R.; Ramanamurthi, M. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The comparative evaluation of neutron activation analysis and direct current plasma emission spectrometry (DCPES) as methods of determination for the elements of interest in the coordinated research programme on "Nuclear Techniques for Toxic Elements in Foodstuffs" is accomplished. We intend to develop neutron activation methods and establish their validity by the analysis of reference materials and intercomparison samples of the Agency and compare the results with those obtained by DCPES. Activation analysis, in view of its high element-specificity, freedom from blank and minimum matrix effect can be used as a reference method to check the results obtained by other methods. The work carried out in the development of neutron activation analysis and DCPES methods under the research contract are summarised in this paper. 9 refs, 1 fig., 4 tabs.

45605 (INIS-mf–11504, pp. 97-110) **Determination of toxic elements in foodstuffs from local market in Jakarta.** Surtipanti Sadjirun (National Atomic Energy Agency, Jakarta (Indonesia). Centre for the Application of Isotopes and Radiation (CAIR)); Suwirma Safri; Endang Rosadi; Yumiarti; Yune Mellawati; Saifudin Simon; Minarni Ak. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The main foodstuffs of Indonesian people are, rice, bean, corn, wheat, vegetables, fruits, meat, fish, milk, tea, and coffee. The problem of the control of toxic elements in foodstuffs have not been carried out such as many countries, so there is no established maximum permissible concentration in the Indonesian national legislation, and that is why Indonesia participates in the Co-ordinated Research Program organized by the International Atomic Energy Agency. This program will allow exchange of experience among the participants, especially in the determination of low level toxic elements in foodstuffs using nuclear techniques. 6 refs, 9 tabs.

45606 (INIS-mf–11504, pp. 111-118) **Toxic and trace elements in foodstuffs in Japan.** Muramatsu, Y. (National Inst. of Radiological Sciences, Ibaraki (Japan)); Sumiya, M.; Ohmomo, Y. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

From the viewpoint of environmental safety assessment it is important to have information on the levels of toxic and trace elements in foodstuffs. It is also essential to develop suitable analytical methods for these elements in order to obtain accurate analytical data. In this paper, two analytical methods were used, inductively-coupled plasma atomic emission spectrometry (ICP-AES) and neutron activation analysis (NAA), for analysing toxic and trace elements in several food samples. 3 tabs.

45607 (INIS-mf–11504, pp. 119-130) **Determination of toxic elements in Malaysian foodstuffs.** Hamzah, Z. (Unit Tenaga Nuklear, Bangi, Selangor (Malaysia)); Wood, A.K.H.; Mahmood, C.S.; Hamzah, S. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

This project is concentrating on the analysis of toxic elements content in seafoods including fishes, mussel, squid and prawn. Samples were collected from various places throughout Malay Peninsular. Samples were prepared according to RCA research protocol - nuclear techniques for toxic element in foodstuffs. Techniques used for elemental analysis were neutron activation analysis (instrumental and radiochemical) and anodic stripping voltametry. (author). 9 refs, 9 tabs.

45608 (INIS-mf–11504, pp. 157-184) **Application of neutron activation analysis technique to the determination of toxic elements in Pakistani foodstuffs.** Qureshi, I.H. (Pakistan Inst. of

Nuclear Science and Technology, Islamabad (Pakistan). Nuclear Chemistry Div.); Mannan, A.; Zaidi, J.H.; Arif, M.; Khalid, N. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

In view of well defined physiochemical roles of essential elements and adverse effects of toxic elements, it is important to obtain fundamental data on trace element nutrition, inadequacy, imbalances and toxicity. In order to achieve these objectives, a research project was initiated in 1985 with the collaboration of the IAEA. Three representative diet samples of the inhabitants of Rawalpindi/Islamabad areas were prepared according to the family income and food habits. Twenty one elements were analysed by NAA and AAS. The dietary intake values were estimated and compared with the suggested daily requirement or tolerance limits. In general, it has been observed that the diets are an adequate source of nutrient elements. The toxic element levels are well below the tolerance limits. (author). 20 refs, 4 figs, 7 tabs.

45609 (INIS-mf–11504, pp. 185-219) **Progress report on analysis for toxic elements in food and drinking water by means of neutron activation analysis.** Leelhaphunt, N.; Chueinta, S.; Dejkumhang, M.; Chueinta, W.; Nouchpramool, S. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

From the view point of environmental safety assessment, it is important to find out the information of the levels of toxic elements in foodstuffs for human consumption so as to establish the maximum permissible concentrations of dietary intake of toxic elements for Thai people. This study will consequently be a great help for Thailand's economics in view of quality assurance of our exported foodstuffs as well as the health and welfare of Thai people. In brief, this research covered the following studies: (a) development of a proper technique for the determination of arsenic (As), cadmium (Cd), copper (Cu) and zinc (Zn) by ion-exchange chromatography, mercury (Hg) and selenium (Se) by direct combustion technique, bromine (Br), cobalt (Co), iron (Fe) and manganese (Mn) by instrumental neutron activation technique, lead (Pb) by flame atomic absorption spectrometry, (b) management of appropriate sample preparation technique, and (c) investigation of the amount of As, Cd, Cu, Zn, Hg, Se, Br, Co, Fe, Mn and Pb in various kinds of vegetables, meat, poultry, bean, peas and various species of rice, fish and shellfish. 4 refs, 1 fig., 25 tabs.

45610 (INIS-mf–11504, pp. 131-155) **Speciation of arsenic in environmental waters.** Eteren, J.T. van (Netherlands Energy Research Foundation, Petten (Netherlands)); Das, H.A.; Ligny, C.L. de; Agterdenbos, J. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

A system for speciation of arsenic in environmental waters by selective hydride formation and on-line AAS is described. Starting from literature data, the separation scheme and the necessary apparatus are outlined. Preliminary practical experience then leads to the formulation of further improvements and accompanying testing experiments. (author). 51 refs, 7 figs, 1 tab.

45611 (INIS-mf–11504, pp. 235-236) **Analytical quality assurance: Results on an intercomparison.** Toro, E.C. (International Atomic Energy Agency, Vienna (Austria)); Parr, R.M. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Published in summary form only. 1 ref.

45612 (INIS-mf–11504, pp. 221-233) **Application of PIXE, NAA and other techniques to the determination of toxic elements in Bangladesh foodstuffs and drinking waters.** Tarafdar, S.A. (Atomic Energy Centre, Dacca (Bangladesh). Chemistry Div.); Khan, A.H. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The main objective of the food monitoring programme is to study the applicability of PIXE, XRF, NAA and other related methods to toxic and essential trace elements analyses in foodstuffs and drinking water under the coordinated research programme of the IAEA and to collect baseline data on the status of such elements in foodstuffs and drinking water. The commonly consumed representative foodstuffs selected for Bangladesh are: rice, wheat, green vegetables, fish, milk and egg. In the previous year, only food items were studied but in this report drinking water is also included. The elements required by the project protocol are Cu, Cr, Fe, As, Se, Sb, Cd, Pb and Hg. In this report, the results obtained during the last contract period are presented with a plan for future work. 4 refs, 2 tabs.

45613 (INIS-mf–11504, pp. 237) **Future of neutron activation analysis - instrumental and radiochemical.** Fardy, J.J. (Commonwealth Scientific and Industrial Research Organization, Lucas Heights (Australia)). International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Abstract only.

45614 (INIS-mf–11504, pp. 239-240) **Radiochemical separations at IPEN (Brazilian Nuclear Energy Commission).** Vasconcellos, M.B.A. (Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil)). International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Published in summary form only.

45615 (INIS-mf–11504, pp. 241-242) **Radiochemical separation for toxic trace elements.** Toro, E.C. (International Atomic Energy Agency, Vienna (Austria)); Ogris, R.; Parr, R.M. International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Published in summary form only. 1 tab.

45616 (INIS-mf–11504, pp. 245) **Selenium in "biological materials" and water.** Das, H.A. (Netherlands Energy Research Foundation, Petten (Netherlands)). International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Published in summary form only.

45617 (INIS-mf–11504, pp. 247) **Preconcentration of trace elements from water samples by sorption - A new approach.** Iyer, R.K. (Bhabha Atomic Research Centre, Bombay (India). Analytical Chemistry Div.). International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Preconcentration of trace elements from water samples is generally carried out by solvent extraction or sorption on suitable sorbents like silica gel, ion exchange resin or activated carbon. 100-500 ml of the aqueous solution is passed through a short column and the sorbed ions are eluted from the column in a small volume. While the accent is on quantitative recovery, the selectivity is not very good especially with respect to alkaline earth elements. A new technique is suggested in this presentation. The same amount of ion exchange resin like Chelex 100 is equilibrated with 4 or 5 successive portions of aqueous solution so that one can achieve good recovery and selectivity. Calculations show that good selectivity can be achieved if the pH and v/m (volume of solution/mass of resin) ratio are so adjusted as to giver greater than 80% recovery in a single equilibration for the ions of interest and less than 50% recovery for the ions to be discriminated against. Preliminary experiments to evaluate recoveries of Zn, Cd and Hg using Chelex 100 resin are in good agreement with the calculations. (author).

45618 (INIS-SU–107/A, pp. 30) **Application of hexamethylphosphotriamide complexes to rapid analysis of rare earth mixtures by ^{1}H and ^{31}P NMR method.** Skopenko, V.V. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Amirkhanov, V.M.; Turov, A.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.*

Short Communication

45619 (INIS-SU–107/A, pp. 58) **PMR determination of Gd(3) ferromagnetic ions in the presence of ethylenediaminetetraacetic acid.** Ruzajkina, L.V. (AN SSSR, Moscow (USSR). Inst. Geokhimii i Analiticheskoj Khimii); Zhukov, M.S.; Fedorov, L.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.

Short Communication

45620 (IPEN-PUB–245) **Evaluation of the laser fluorimetric method in the determination of uranium.** Ranieri, I.M.; Cantagallo, M.I.C.; Vieira, M.M.F.; Iyer, S.S.S.; Morato, S.P. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Feb 1989. 13p. (In Portuguese). Order Number DE89636052/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Application of laser fluorimetry for the determination of trace levels of uranium in aqueous samples has been evaluated. The various parameters that may influence the sensitivity and accuracy of the method have been investigated. It was verified that the method is applicable to samples in the concentration range between 1 to 100 ppb U. The precision is 9% in the 1 ppb U level and 2% for 100 ppb. (author).

45621 (KCP–613-4096) **Supercritical fluid chromatography: Application of a new technique for analysis and materials characterization: Final report.** Dubiel, S.V. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1989. 69p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. Order Number DE89015205/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Eleven organic materials used at Allied-Signal Inc., Kansas City Division (KCD), have been analyzed using supercritical fluid chromatography (SFC). This work was undertaken to determine the potential applications of SFC for acceptance testing and material characterization. Gas chromatography (GC) and high performance liquid chromatography (HPLC) are also included for comparison with the resolution obtained with SFC. In addition, thermogravimetric analyses of the samples were performed to indicate the amount of sample material expected to volatilize from the hot injection port of the GC. With SFC, the analytical results contributed significantly more information than one would expect to obtain from either GC or HPLC. These results will be an encouragement to seek support at KCD for developing this technique to provide new and expanded information not readily obtained in any other way. 13 refs., 43 figs., 2 tabs.

45622 (MRP/MSL–84-147(IR)) **Gamma-ray methodology for the determination of lead-210 in mineralogical materials.** Smith, C.W.; Yang Junhao. Canada Centre for Mineral and Energy Technology, Ottawa, ON (Canada). Mining Research Labs. Nov 1984. 24p. Order Number DE89636019/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Lead-210 activities in CCRMP uranium reference materials DL-1a, BL-4a, DH-1a and BL-5 were measured from the 46.52 KeV gamma-ray photopeak intensities using a 1000 mm^2 x 5 mm intrinsic germanium detector. Calibration was performed with aliquots of ^{210}Pb certified reference material RBZ.44 adsorbed on a variety of mineralogical matrices. Data were corrected for sample-dependent dead-time and self-absorption effects on the photopeak area. Self-absorption correction was based on photopeak attenuation coefficients determined experimentally for each sample from transmission measurements with a 74 kBq ^{210}Pb source, assuming a simple exponential attenuation law applies. Results were in good agreement with those obtained by the method of standard additions. The activities obtained were 1.38 +- 0.05, 15.72 +- 0.33, 31.68 +- 0.58, and 862 +- 18 Bq g^{-1} respectively for the references materials, the uncertainties being 95% confidence intervals for the means of four determinations.

45623 (OH/RD–88-29-K) **A review of the requirements for accreditation of the analytical services section laboratory.** Curtis, K.E. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 23p. (MICROLOG–89-02597). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C/ CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Analytical Services Section has investigated the merits of various laboratory accreditation programs currently available. Most have been found to be either inadequate or not structured in a way to cover the multitude of tests and testing technologies that are routinely carried out. Two prorams that could possibly meet the Section's requirements are offered by the Standards Council of Canada and the American Association for Laboratory Accreditation. However, the amount of work and effort required to apply for a blanket accreditation with either of these outweighs any advantages that might be obtained. If this topic is pursued any further, any initial application for accreditation should be for only a few selected procedures. Additional procedures could then be added in the future, if

and when it is found to be desirable. The most realistic scenario is that further action be postponed until various Ontario regulatory bodies, such as the Ministry of the Environment, introduce their own accreditation programs (possily mandatory) for specific tests or testing technologies. 3 refs.

45624 (PB–89-866032/XAB) **Anion-exchange resins: Structure, formulation, and applications. January 1977-July 1989 (Citations from the Rubber and Plastics Research Association data base). Report for January 1977-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 86p. Available from NTISPC N01/MF N01.

Supersedes PB–87-860102.

This bibliography contains citations concerning the formulation and synthesis of anion-exchange resins based on such resins as amides, polyethylenes and styrenes. Osmotic properties, exchange-kinetics behavior, sorption properties, structure studies and temperature-related-performance effects on anion-exchange resins are considered. Anion-exchange chromatography of metals and liquids, and applications in water purification and pollution control are included. (This updated bibliography contains 169 citations, 24 of which are new entries to the previous edition.)

45625 (PNL-SA–16651) **Tandem mass spectrometry of multiply charged peptides and proteins.** Barinaga, C.J.; Udseth, H.R.; Smith, R.D. Pacific Northwest Lab., Richland, WA (USA). May 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. (CONF-8905166–8: American Society for Mass Spectroscopy annual symposium, 22-26 May 1989). Order Number DE89016028/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In the past two years electrospray ionization (ESI), originally described by Dole and coworkers and reinvigorated by Fenn and coworkers, has received considerable attention as a soft ionization source for mass spectrometry. The ESI method produces intact, multiply charged, gas phase molecular ions of peptides and proteins from aqueous solution with mass to charge ratios (m/a) that are easily within the range of quadrupole mass spectrometers. Because of the possible additional structural information from collisionally induced dissociation (CID)/tandem mass spectrometry, multiply charged ions are likely candidates for examination by this technique, possibly producing all or significant portions of the amino acid sequence. Although the multiply charged ions give abundant fragmentation, it is still a question whether meaningful fragmentation can be efficiently produced by CID. It would also be anticipated that the charge state of the parent ion might significantly affect the daughter ion spectra both in ions observed and their intensities. Three peptides, mellitin, glucagon, and the synthetic T_1 trypstic fragment of glucagon, and the protein cytochrome-c, have been investigated to examine these issues. 5 refs., 1 fig.

45626 (UCRL–50007-87, pp. 136-143) **Analysis of fire and smoke threat to off-gas HEPA filters in a transuranium processing plant.** Alvares, N.J. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

The author performed an analysis of fire risk to the high-efficiency particulate air (HEPA) filters that provide ventilation containment for a transuranium processing plant at the Oak Ridge National Laboratory. A fire-safety survey by an independent fire-protection consulting company had identified the HEPA filters in the facility's off-gas containment ventilation system as being at risk from fire effects. Independently studied were the ventilation networks and flow dynamics, and typical fuel loads were analyzed. It was found that virtually no condition for fire initiation exists and that, even if a fire started, its consequences would be minimal as a result of standard shut-down procedures. Moreover, the installed fire-protection system would limit any fire and thus would further reduce smoke or heat exposure to the ventilation components. 4 references, 4 figures, 5 tables.

45627 High precision methods of neutron activation analysis applied to geochemistry. Perlman, I. (Lawrence Berkeley Lab., CA (USA)); Asaro, F.; Michel, H.V. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809240–: Symposium on application of nuclear techniques to geochemistry, 25-30 Sep 1988).

Neutron activation analysis is a technique for measuring abundances of chemical elements, which differs from other methods in that it is based upon nuclear reactions instead of chemistry. This characteristic has special relevance for geochemistry because of its inherent sensitivity for trace elements which cannot be reached by other methods. 99% of the earth's crust is made up of just 8 elements, whereas the remaining 1% must accommodate 70-odd rock building trace elements of which about half can be measured by neutron activation analysis. In recent years, there has been much interest in these trace elements because they encompass diverse chemical properties. The present discussion of the technique is based upon more than 15 years of experience at the Lawrence Berkeley Laboratory and The Hebrew University of Jerusalem. This is not meant to intimate that the practices in other laboratories do not merit attention. Perhaps our approach differs from other published work in the emphasis given to sources of error and learning how to control them.

45628 Extraction of actinides with lipophilic crown ether carboxylic acids. Wai, C.M. (Univ. of Idaho, Moscow (USA)); Tang, Jian; Nitsche, H.; Hoffman, D.C. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809278–: American Chemical Society Division of Nuclear Chemistry and Technology, 25-30 Sep 1988).

Americium(III) and Californium(III) in aqueous solutions can be extracted by symdibenzo-16-crown-5-oxyacetic acid and its modified analogues into chloroform at pH > 4. The recoveries of Am^{3+} and Cf^{3+} are nearly quantitative at pH around 6. In general, increasing the length of the side arm alkyl group increases the lipophilicity of the crown ether carboxylic acids and enhances the distribution ratio of the actinide-macrocycle complexes in the organic phase. This type of crown ether with pendant carboxylate groups may be a new class of chelating agents for selective extraction of actinides based on the ionic radius-cavity size compatibility concept.

45629 Preparation of UO_3 sol-gel feedstock. Tinkle, M.C. (Los Alamos National Lab., NM (USA)); Hensley, C.A.; DeVelasco, R.I. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809278–: American Chemical Society Division of Nuclear Chemistry and Technology, 25-30 Sep 1988).

A UO_3 feedstock was required for the production of sol-gel kernals to be used in reactor fuels. A method was developed for producing kilogram quantities of this uO_3 feedstock using standard laboratory equipment. The feedstock was prepared in both depleted and enriched UO_3. This method of preparation compared favorably with the earlier denitration processes. A quantitative precipitate of $UO_4 \times H_2O$ was prepared from 1M uranyl nitrate solution by the simultaneous addition of H_2O_2 and NH_4OH at a pH of 2.0 in the presence of malonic and citric acids in a stirred beaker. The precipitate was separated by filtration and calcined at 450°C to obtain a composition approximating UO_3. This UO_3 was sieved to minus 30 mesh and blended to assure uniformity. The resulting UO_3 sol-gel feedstock contained about 80 wt% uranium.

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Refer also to citation(s) 44428, 44431, 44439, 44532, 44837, 45005, 45559, 45733, 45734, 46037, 46041, 46180, 46388, 46599

45630 (CONF-890805–1-Draft) **The base catalyzed hydrolysis and condensation reactions of dilute and concentrated TEOS [Tetraethylorthosilicate] solutions: Draft.** Harris, M.T.; Byers, C.H.; Brunson, R.R. Oak Ridge National Lab., TN (USA). 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 5. international workshop on glasses and ceramics from gels; 6-10 Aug 1989. Order Number DE89016161/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The synthesis of submicron silica particles by the hydrolysis and condensation of dilute and concentrated solutions of tetraethylorthosiliate (TEOS) has been studied in low-molecular weight

alcohols (C_1–C_4). A base (ammonia) is used to catalyze the reaction. Raman spectroscopy, gas chromatography and the molybdate method are used to establish the hydrolysis and condensation kinetics. Dynamic and classical light-scattering techniques are employed to monitor particle growth and particle number concentration kinetics, and particle size distribution. The effects of solvent and TEOS concentration on the degree of monodispersity of the particles will be discussed. Furthermore, the chemical and particle growth data will be used to test the theories of homogeneous nucleation and coagulative nucleation, which have been proposed as the mechanisms that govern the growth of submicron monodisperse silica particle by TEOS hydrolysis. 13 refs., 4 figs., 1 tab.

45631 (CONF-8909120–1) **Computer simulations of polymer dynamics in the solid state.** Sumpter, B.G.; Noid, D.W.; Wunderlich, B. Oak Ridge National Lab., TN (USA); Tennessee Univ., Knoxville, TN (USA). Dept. of Chemistry. 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From American Physical Society (APS) meeting; 5-8 Sep 1989. Order Number DE89010337/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

Details at the atomic or molecular level are important for a more thorough understanding of polymer processes. A better knowledge of both structure and dynamics is needed. A method which is particularly suited for this task is the molecular dynamics method (MD). The method is well known, but its application to the solid state of polymers has not been extensive. Indeed, polymer applications present some unique difficulties to be discussed in the next section. In our detailed computer simulations of the dynamics of solid polymers, we have focused on the following three topics: (a) simulations of condis crystals and meso-phase transitions, (b) melting and crystallization of polymers, and (c) calculation of vibrational spectra and heat capacities of solids. 13 refs., 1 fig.

45632 (IC–89/60) **On condensation driven by electrostatic interactions in macroionic solutions.** Badirkhan, Z.; Tosi, M.P. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 10p. Order Number DE89636072/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Liquid-vapour phase separation, as it normally follows from attractive interactions, is demonstrated under pure Coulomb interactions for the primitive model of macroionic solutions in the mean spherical approximation and related to observations on dilute solutions of highly charged latex particles. It is stressed that the corresponding effective pair potential between macro-ions is of the DLVO repulsive type. (author). 14 refs, 2 figs.

45633 (INIS-SU–89, pp. 68-69) **Melts of rare alkali metal salts as solvents of refractory oxides.** Lupejko, T.G. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR)); Zyablin, V.N. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.
Short Communication

45634 (INIS-SU–89, pp. 76-77) **Choice of conditions of monocrystal growth and purification of Li, Rb and Cs salts expert system "ternary phase diagrams".** Vorob'ev, V.P. (AN SSSR, Ulan-Ude (USSR). Inst. Estestvennykh Nauk); Lutsyk, V.I.; Sumkina, O.G. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.
Short Communication

45635 (INIS-SU–89, pp. 110) **Comparative evaluation of efficiency of cesium separation from industrial solutions using ferrocyanides of the type $Cs_2Me(Fe(CN)_6)$, where M - Ca, Zn, Cu, Co.** Shklovskaya, R.M.; Arkhipov, S.M. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.
Short Communication

45636 (INIS-SU–89, pp. 118) **Distribution coefficients of microimpurities during crystallization of cesium, sodium iodides from aqueous solutions.** Tarasov, V.A.; Zuber, V.M.; Demirskaya, O.V.; Smirnova, O.M.; Vlasova, I.D. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.
Short Communication

45637 (INIS-SU–89, pp. 168-169) **Formation of stucture of rare alkali element polyferrites.** Sheka, I.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Obshchej i Neorganicheskoj Khimii); Novosadova, E.B.; Didukh, I.R.; Belous, A.G. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.
Short Communication

45638 (INIS-SU–89, pp. 181) **Phase equilibria in the systems including lithium tetrafluoroborate or hexafluoroarsenate and dipolar aprotic solvents.** Kovtun, Yu.V. (Dnepropetrovskij Inst. Inzhenerov Zheleznodorozhnogo Transporta, Dnepropetrovsk (Ukrainian SSR)); Plakhotnik, V.N. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.
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45639 (INIS-SU–89, pp. 187-188) **Physicochemical properties of electrolytes based on lithium tetrafluoroborate and mixtures of dipolar aprotic solvents with participation of glines.** Shamakhova, N.N. (Dnepropetrovskij Inst. Inzhenerov Zheleznodorozhnogo Transporta, Dnepropetrovsk (Ukrainian SSR)); Plakhotnik, V.N.; Ivankova, E.Ya.; Shembel', E.M.; Lipets, T.N.; Skakal'skij, A.I.; Yaryshkina, L.A.; Chaukina, L.V. AN SSSR, Apatity (USSR). Inst. Khimii i Tekhnologii Redkikh Ehlementov i Mineral'nogo Syr'ya. 1988. (In Russian). In *7. All-union conference on chemistry and technology of rare alkali elements. Summaries of reports.* Order Number DE89012153/JAW. Available from NTIS (US Sales Only), PC A10/MF A01; INIS.
Short Communication

45640 (INIS-SU–107/A) **5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.** AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. 342p. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.

Selected papers have been processed separately. (DLC)

45641 (INIS-SU–107/A, pp. 4-5) **Lability of transition metal solvate complexes.** Shtyrlin, V.G. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Zakharov, A.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number

DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45642 (INIS-SU–107/A, pp. 16) **Stereochemistry of coordination compounds of chromium (5), molybdenum (5), and tungsten (5).** Trachevskij, V.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Kolloidnoj Khimii i Khimii Vody). AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45643 (INIS-SU–107/A, pp. 8) **Structure of scandium (3) coordination compounds from the ^{45}Sc NMR data.** Kirakosyan, G.A.; Tarasov, V.P. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45644 (INIS-SU–107/A, pp. 18) **^{19}F and ^{125}Te NMR of Te(4) chelate dioiatofluoride complexes.** Kokunov, Yu.V.; Afanas'ev, V.M.; Gustyakova, M.P.; Buslaev, Yu.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45645 (INIS-SU–107/A, pp. 23) **Solvolysis of fluorotelluric acids in hydrogen peroxide solutions.** Chernyshov, B.N. (AN SSSR, Vladivostok (USSR). Inst. Khimii); Kokuniv, Yu.V.; Vasilyuk, N.S. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45646 (INIS-SU–107/A, pp. 24) **Study of regularities of LSR complexing with symmetric cationic cyanine dyes.** Ishchenko, A.A. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Organicheskoj Khimii); Derevyanko, N.A.; Komarov, I.V.; Turov, A.V.; Kornilov, M.Yu. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45647 (INIS-SU–107/A, pp. 25) **PMR study of tautomeric forms of salicyihydroxamic acid and its complexes with molybdenum (6).** Sharipov, Kh.T. (AN Uzbekskoj SSR, Tashkent (USSR). Inst. Khimii); Alimova, G.A.; Tananaeva, N.N.; Makhmudova, N.K. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45648 (INIS-SU–107/A, pp. 27) **Temperature dependence anomalies of lanthanide induced shifts in PRM spectra of isoflavenoids.** Khilya, V.N. (Kievskij Gosudarstvennyj Univ., Kiev (Ukrainian SSR)); Turov, A.V.; Komarov, I.V.; Kornilov, M.Yu. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45649 (INIS-SU–107/A, pp. 33) **NMR study of tantalum pentafluoride complexing with trimethylsilyl ether.** Il'in, E.G.; Kopanev, V.D.; Sokolov, V.V.; Ignatov, M.E. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45650 (INIS-SU–107/A, pp. 34) **^{1}H and ^{13}C NMR study of structure and stability of heteroligand complexes formed by certain rare earths with chelating agents, derivatives of dicarboxylic acids, and citric acid.** Gorelov, I.P. (Kalininskij Gosudarstvennyj Univ., Kaliningrad (USSR)); Konova, T.A.; Majorova, L.A.; Nser Khanan. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45651 (INIS-SU–107/A, pp. 38) **Interaction of indium fluorocomplexes with N-donor ligands from the ^{19}F NMR data.** Petrosyants, S.P.; Malyarik, M.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po

Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45652 (INIS-SU–107/A, pp. 39) **Composition and structure of interstitial products of phenylisocyanate and acetonitrile to tantalum-chlorine bond from the PMR data.** Ovchinnikova, N.A.; Afanas'ev, V.M.; Sakharov, S.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45653 (INIS-SU–107/A, pp. 40) **Geometric structure study of different-ligand complexes of the heaviest lanthanides from the NMR data and NMR relaxation spectroscopy (RS) data.** Babajlov, S.P. (AN SSSR, Novosibirsk (USSR). Inst. Neorganicheskoj Khimii); Kriger, Yu.G.; Martynova, T.M.; Nikulina, L.D. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45654 (INIS-SU–107/A, pp. 29) **New isotope effects in ion nuclei relaxation in electrolyte aqueous solutions.** Mazitov, R.K. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Ismaev, I.Eh.; Il'yasov, A.V.; Gejst, A.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45655 (INIS-SU–107/A, pp. 41) **Effect of ClO_4^- anions on Yb(3) induced paramagnetic shifts in PMR spectra of aquaacidocomplexes in water-acetone solutions.** Kavun, V.Ya. (AN SSSR, Vladivostok (USSR). Inst. Khimii); Buikliskij, V.D. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45656 (INIS-SU–107/A, pp. 42) **On the LICl effect on NMR spectra of Yb(3) complex with L-histidine.** Buikliskij, V.D. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45657 (INIS-SU–107/A, pp. 43) **PMR in the study of structure and thermal stability of group 3 element paratungstates.** Belousova, E.E. (Donetskij Gosudarstvennyj Univ., Donetsk (Ukrainian SSR)); Krivobok, V.I.; Barash, A.B. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45658 (INIS-SU–107/A, pp. 51) **NMR and ionic mollility in compounds on the basis of polyvanadic acid.** Arsenov, S.G. (AN SSSR, Sverdlovsk (USSR). Inst. Khimii); Pletnev, R.N.; Volkov, V.L.; Dmitriev, A.V.; Denisova, T.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45659 (INIS-SU–107/A, pp. 52) **Investigation characteristics of paramagnetic ion interaction with chelating agents in mineral acid solutions from the NMR-relaxation and spectrophotometry data.** Saprykova, Z.A. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Amirov, R.R. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45660 (INIS-SU–107/A, pp. 55) **Change in NMR parameters of rare earth complexes with acetic acid in the presence of diamagnetic salt.** Buikliskij, V.D.; Bukov, N.N.; Lavrent'ev, E.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.

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45661 (INIS-SU–107/A, pp. 65) **On the behaviour of different-ligand complexes of Zn^{2+} and Cd^{2+} diethyldithiocarbamates with ethylenediamine in organic media.** Zemskova, S.M. (AN SSSR, Novosibirsk (USSR). Inst. Neorganicheskoj Khimii); Glukhikh, L.K.; Oglezneva, I.M.; Kirichenko, V.N.; Larionov, S.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45662 (INIS-SU–107/A, pp. 70) **^{35}NQR, vibrational (laser Raman,- IR) spectra and structure of hetro,- binuclear complexes of ruthenium and rhodium chlorides with chalcogen chlorides.** Volkov, S.V.; Pekhn'o, V.I.; Grafov, A.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45663 (INIS-SU–107/A, pp. 82) **PMR and thermolysis features of tungstogallates of alkali- and alkaline earth metals.** Maksimova, L.G. (AN SSSR, Sverdlovsk (USSR). Inst. Khimii); Denisova, T.A.; Pletnev, R.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45664 (INIS-SU–107/A, pp. 98) **Sc(3) complexing in phosphorus-containing ion-exchange resins from the ^{31}P NMR data.** Randarevich, S.B.; Korovin, B.Yu.; Zhukova, N.G.; Polyakova, O.P.; Bodaratskij, S.V.; Fatueva, G.G.; Trachevskij, V.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45665 (INIS-SU–107/A, pp. 108) **NMR optical spectroscopy and the structure of lanthanide complexes with DTPA derivatives.** Babushkina, T.A. (Institut Biofiziki, Moscow (USSR)); Zolin, V.F.; Koreneva, L.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45666 (INIS-SU–107/A, pp. 109) **NMR spectroscopy study of the composition of molybdovanadosilicic heteropolyacid solutions.** Detusheva, L.G. (AN SSSR, Novosibirsk (USSR). Inst. Kataliza); Yurchenko, Eh.N.; Fedotov, M.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45667 (INIS-SU–107/A, pp. 110) **NMR spectra and structure of lanthanide complexes with water-soluble porphyrins.** Babushkina, T.A. (Institut Biofiziki, Moscow (USSR)); Zolin, V.F.; Koreneva, L.G.; Rumyantseva, V.D.; Mironov, A.F. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45668 (INIS-SU–107/A, pp. 106) **Quantum-chemical analysis of ^{19}F NMR chemical shifts in hexafluorocomplex groupings.** Vuznik, V.M. (Krasnoyarskij Gosudarstvennyj Univ., Krasnoyarsk (USSR)); Nejman, K.M. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45669 (INIS-SU–107/A, pp. 117) **Nuclear magnetic relaxation study of paramagnetic 3d-element ion complexes with hydroxycarboxylic acids.** Sal'nikov, Yu.I. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Kuz'mina, N.L.; Zhuravleva, N.E. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45670 (INIS-SU–107/A, pp. 118) **NMR and electron spectroscopy study of outer-sphere complexing in aqueous solutions containing transition and alkali metal ions.** Borina, A.F.; Mazitov, R.K.; Gejst, A.G. AN SSSR, Moscow (USSR); Ministerstvo

Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45671 (INIS-SU--107/A, pp. 120) **Stereodynamics study of zinc, cadmium, and nickel complexes on the basis of 2,3-mercaptonaphthaldehyde imines.** Korobov, M.S. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR). Nauchno-Issledovatel'skij Inst. Fizicheskoj i Organicheskoj Khimii); Olekhnovich, R.Ya.; Borodkin, G.S.; Nivorozhkin, L.E.; Minkin, V.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45672 (INIS-SU--107/A, pp. 121) **Structural nonrigidity of tetrahedral Zn(2) and Be(2) complexes on the basis of 4-substituted 2,6-diformylphenol diimines.** Korobov, M.S. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR). Nauchno-Issledovatel'skij Inst. Fizicheskoj i Organicheskoj Khimii); Borodkin, G.S.; Nivorozhkin, L.E.; Minkin, V.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45673 (INIS-SU--107/A, pp. 123) **Dynamic ^{1}H NMR study of sulfur-containing zinc and cadmium complexes on the basis of alterdentate ligands.** Korobov, M.S. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR). Nauchno-Issledovatel'skij Inst. Fizicheskoj i Organicheskoj Khimii); Borodkin, G.S.; Nivorozhkin, L.E.; Minkin, V.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45674 (INIS-SU--107/A, pp. 125) **Structure and stoichiometry of paramagnetic cation solvate complexes in binary water-organic solvents from the proton magnetic relaxation and paramagnetic birefringence data.** Devyatov, F.V. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Vul'fson, S.G.; Nepryakhin, A.E.; Safika, V.F.; Vereshchagin, A.N.; Sal'nikov, Yu.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45675 (INIS-SU--107/A, pp. 126) **PMR- and IR-spectroscopy study of interaction of alkali metal perchlorates and chlorides with polyethylene glycols.** Krasnoperova, L.P. (Khar'kovskij Gosudarstvennyj Univ., Kharkov (Ukrainian SSR)); Pivnenko, N.S.; Surov, Yu.N.; Zudochkina, L.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45676 (INIS-SU--107/A, pp. 129) **NMR spectra and structure of lanthanide complexes with phthalocyanines.** Babushkina, T.A. (Institut Biofiziki, Moscow (USSR)); Zolin, V.F.; Koreneva, L.G.; Luk'yanets, E.A.; Tomilova, L.G. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45677 (INIS-SU--107/A, pp. 131) **^{1}H NMR study of new trinuclear pyrazolaldiminate metallochelates, constaining phenylchromiumtricarbonyl fragment.** Uraev, A.I. (Rostovskij-na-Donu Gosudarstvennyj Univ., Rostov-na-Donu (USSR). Nauchno-Issledovatel'skij Inst. Fizicheskoj i Organicheskoj Khimii); Novorozhkin, A.L.; Frenkel', A.S.; Konstantinovskij, L.E.; Magomedov, G.K.; Garnovskij, A.D. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45678 (INIS-SU--107/A, pp. 133) **Water state in hydrated rare earth metal oxidates.** Sharov, V.A. (Ural'skij Politekhnicheskij Inst., Sverdlovsk (USSR)); Pletnev, R.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413--: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45679 (INIS-SU–107/A, pp. 137) **PMR study of rare earth compound interaction with ε-aminocaproic acid.** Proskurina, E.M. (Moskovskij Inst. Tonkoj Khimicheskoj Tekhnologii, Moscow (USSR)); Yastrebov, V.V.; Galaktionova, O.V.; Lebedeva, E.N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45680 (INIS-SU–107/A, pp. 141) **^{31}P, ^{183}W, ^{17}O NMR of paramagnetic complexes ($Ln(PW_{11}O_{39})_2)^{11-}$ in aqueous solutions (Ln-rare earths).** Fedotov, M.A. (AN SSSR, Novosibirsk (USSR). Inst. Kataliza); Pertsikov, B.Z.; Danovich, D.K. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45681 (INIS-SU–107/A, pp. 142) **Rare-earth ion hydrate-shell structure from the quadrupole-nuclei NMR-relaxation data.** Chizhik, V.I. (Leningradskij Gosudarstvennyj Univ., Leningrad (USSR)); Kabal', K.; Flejtas, N. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45682 (INIS-SU–107/A, pp. 100) **NM Relaxation and spectral characteristics of molybdenun (3) complexes in HCl aqueous solutions.** Chichirova, N.D. (Kazanskij Gosudarstvennyj Univ., Kazan (USSR)); Saprykova, Z.A.; Sal'pikov, Yu.I. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45683 (INIS-SU–107/A, pp. 103) **^{31}P NMR study of organic phosphorus compounds complexing with the surfaces of porous materials.** Randarevich, S.V. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Obshchej i Neorganicheskoj Khimii); Korovin, V.Yu.; Platonov, V.A.; Merkulov, V.A.; Trachevskij, V.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45684 (INIS-SU–107/A, pp. 107) **NMR optical spectroscopy at fast ligand exchange.** Koreneva, L.G. (AN SSSR, Moscow (USSR). Inst. Radiotekhniki i Ehlektroniki); Zolin, V.F. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
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45685 (INIS-SU–107/A, pp. 116) **NMR study of distortion mechanisms of highly symmetric complex ions in crystals.** Kozlova, S.G. (AN SSSR, Novosibirsk (USSR). Inst. Neorganicheskoj Khimii); Moroz, N.K.; Gabuda, S.P. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.
Short Communication

45686 (INIS-SU–111/A, pp. 15-16) **Epitaxy of solid solutions and multilayer structure in cadmium-mercury-tellurium system.** Sidorov, Yu.G. (AN SSSR, Novosibirsk (USSR). Inst. Fiziki Poluprovodnikov); Chikichev, S.I. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
'Short Communication.'

45687 (INIS-SU–111/A, pp. 18-19) **Molecular beam epitaxy of dielectric layers of fluorides of alkaline earth and rare earth elements on semiconductors.** Sokolov, N.S. (AN SSSR, Leningrad (USSR). Fiziko-Tekhnicheskij Inst.). AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
'Short Communication.'

45688 (INIS-SU–111/A, pp. 39-40) **Molecular beam epitaxy of CdTe films on (100) GaAs.** Dvoretskij, S.A. (AN SSSR, Novosibirsk (USSR). Inst. Fiziki Poluprovodnikov); Zubkov, V.P.; Kalinin, V.V.; Kuz'min, V.D.; Sidorov, Yu.G.; Stenin, S.I. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

45689 (INIS-SU–111/A, pp. 67-68) **Segregation of indium during InGaAs film growth by the method of molecular beam epitaxy.** Revenko, M.A. (AN SSSR, Novosibirsk (USSR). Inst. Fiziki Poluprovodnikov); Rubanov, S.V.; Fedorov, A.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number

DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

45690 (INIS-SU-111/A, pp. 121) **Valence of atoms in samarium films, applied to face (100) of tungsten.** Efimovskij, S.E. (AN SSSR, Leningrad (USSR). Fiziko-Tekhnicheskij Inst.); Loginov, M.V.; Mittsev, M.A. AN SSSR, Moscow (USSR); Ministerstvo Khimicheskoj Promyshlennosti SSSR, Moscow (USSR). 1988. (In Russian). (CONF-8811251–: 7. All-Union conference on crystal growth, 14 Nov 1988). In *Molecular beam epitaxy. Surface. Vol. 4. Extended theses.* Order Number DE89012207/JAW. Available from NTIS (US Sales Only), PC A08/MF A01; INIS.
Short Communication

45691 (LA-UR-89-2170) **Critical reaction rates in hypersonic combustion chemistry.** Oldenborg, R.C.; Harradine, D.M.; Loge, G.W.; Lyman, J.L.; Schott, G.L.; Winn, K.R. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-890902–12: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89014278/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

High Mach number flight requires that the scramjet propulsion system operate at a relatively low static inlet pressure and a high inlet temperature. These two constraints can lead to extremely high temperatures in the combustor, yielding high densities of radical species and correspondingly poor chemical combustion efficiency. As the temperature drops in the nozzle expansion, recombination of these excess radicals can produce more product species, higher heat yield, and potentially more thrust. The extent to which the chemical efficiency can be enhanced in the nozzle expansion depends directly on the rate of the radical recombination reactions. A comprehensive assessment of the important chemical processes and an experimental validation of the critical rate parameters is therefore required if accurate predictions of scramjet performance are to be obtained. This report covers the identification of critical reactions, and the critical reaction rates in hypersonic combustion chemistry. 4 refs., 2 figs.

45692 (LA-UR-89-2561) **Spectroscopy of the amide-I modes of acetanilide.** Bigio, I.J.; Scott, A.C.; Johnston, C.T. Los Alamos National Lab., NM (USA). 1989. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8907120–1: NATO research workshop on self-trapping of vibrational energy in protein, 30 Jul - 4 aug 1989). Order Number DE89015282/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Raman measurements were made on acetanilide (N-phenylacetamide). Data are presented of the integrated intensity of the 1650 cm^{-1} band as a function of temperature. The experimental procedures and data reduction were highly rigorous and are believed to be to most reliable data available. A concise theory of polaron states is presented and used to interpret the data. 22 refs., 4 figs., 1 tab.

45693 (LBL–26513) **Applications of NMR spectroscopy to the study of zeolite synthesis.** Bell, A.T. Lawrence Berkeley Lab., CA (USA). May 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8809384–1: ACS meeting on advances in zeolite synthesis, 25-30 Sep 1988). Order Number DE89015226/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

NMR spectroscopy is a powerful technique for identifying the structure and concentration of silicate and aluminosilicate anions in gels and solution used for zeolite synthesis. A review is presented of the types of species that have been observed and the dependence of the distribution of these species on pH and the nature of the cations present. 19 refs., 10 figs., 3 tabs.

45694 (MLM–3527, pp. 3-25) **Separation research; Calcium chemical exchange.** Jepson, B.E.; Evans, W.F.; Figgins, P.E. Monsanto Research Corp., Miamisburg, OH (USA). Mound. 29 Jul 1988. In *Mound activities in chemical and physical research, July-December 1987.* Order Number DE89015149/JAW. Available from NTIS, PC A03/MF A01.

The enrichment of calcium isotopes of chemical exchange relies on the tendency of the heavy calcium isotopes to preferentially occupy one of the phases of a two-phase system at equilibrium. This enrichment is described by the equilibrium single-stage separation factor, α, which is defined, where n represents the atom fraction of a particular isotope and A and B identify the phase in which these atom fractions occur. Isotope ratios were obtained for the natural abundance calcium feed material at intervals during the sample analysis period. The $^{40}Ca/^{44}Ca$ ratios averaged 46.64 $\pm$ 0.03. The $^{48}Ca/^{44}Ca$ ration average was 0.0885 $\pm$ 0.00014.

45695 (MLM–3527, pp. 26-33) **Liquid phase thermal diffusion.** Rutherford, W.M. Monsanto Research Corp., Miamisburg, OH (USA). Mound. 29 Jul 1988. In *Mound activities in chemical and physical research, July-December 1987.* Order Number DE89015149/JAW. Available from NTIS, PC A03/MF A01.

Previous research has shown that the isotopic thermal diffusion factor in substituted benzenes and in carbon disulfide is dependent on relative differences in mass between diffusing molecules and also on differences in the distribution of mass within the molecules [5,6]. The current series of experiments was extended to include measurements of the thermal diffusion separation of isotopically substituted bromine in several of the lower alkyl bromides. Silicon isotopes can be separated by liquid phase thermal diffusion of organosilicon compounds. The thermal diffusion factor for the ^{30}Si-^{28}Si pair in tetramethylsilane was found to be large enough to support practical scale experiments, and the fluid was found to be chemically stable for extended periods at normal operating temperatures.

45696 (SAND–89-0990C) **Thermochemical model for shock-induced chemical reactions in porous thermite: The heat detonation model.** Boslough, M.B. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–12: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016528/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A thermochemical model has been developed that treats a shock-induced solid state chemical reaction as a special type of detonation, called a "heat detonation" to distinguish it from an ordinary explosive detonation and describe the final form that the chemical energy takes. According to shock temperature measurements, chemical energy can be released from porous reactive solids on a time scale shorter than shock-transit times in laboratory samples. By comparing the experimental shock temperature for porous thermite to that calculated by the model, the amount of thermite reacted when shocked to about 4 GPa was estimated to be between 60 and 70%. Calculated shock temperatures are extremely strong functions of the extent of reaction, but are relatively insensitive to the initial porosity and amount of volatile impurities. Thus, shock temperature measurements are the most useful for real-time studies of shock-induced exothermic chemical reactions in solids. 11 refs., 5 figs., 1 tab.

45697 (SI-R–860220-3) **Synthesis of surfactant. Final report.** Daasvatn, K. Senter for Industriforskning, Oslo (Norway). Jun 1988. 26p. (In Norwegian). Order Number DE89914746/JAW. Available from NTIS (US Sales Only), PC A03.

The report describes synthesis strategies of different oxyethynated surfactants. The chosen methods secure a pure well defined synthesis product ie. an isomeric pure alkylchain and oligomeric pure oxyethylene chain. 27 figures, 2 tables.

45698 (UCRL–101434) **Theoretical hugoniot of liquid hydrogen fluoride.** Ree, F.H.; Calef, D.F. Lawrence Livermore National Lab., CA (USA). Jul 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890812–14: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016504/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A new temperature-dependent exponential-six potential for HF is presented for high-temperature applications. We use it to examine

effects of hydrogen bonding in liquid HF under shock conditions. 9 refs., 3 figs.

45699 (UCRL–101488) **Absorption of shocked benzene.** Holmes, N.C.; Otani, G.; McCandless, P.; Rice, S.F. Lawrence Livermore National Lab., CA (USA). Jul 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890798–9: AIRAPT and EHPRG international high pressure science and technology conference, 17-21 Jul 1989). Order Number DE89016503/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We used absorption spectroscopy to observe decomposition of benzene (C_6H_6) subjected to the passage of strong shock waves generated by projectile impact. These measurements were made using a recently developed double-beam, double-pass, fiber-optic-coupled apparatus. Near 13GPa, we observe absorption throughout most of the visible region, with strong absorption occurring for wavelengths below 400 nm. The absorption is most likely due to a combination of molecular absorption and Mie scattering from carbon particles formed as a result of shock decomposition. 6 refs., 4 figs.

45700 Ligand-substitution and electron-transfer reactions of pentacoordinate copper (I) complexes. Goodwin, J.A. (William Marsh Rice Univ., Houston, TX (USA)); Wilson, L.J.; Stanbury, D.M.; Scott, R.A. *Inorganic Chemistry (USA),* 28(1): 42-50 (11 Jan 1989).

The kinetics of the electron self-exchange for the Cu(I)/Cu(II) couple of the pentacoordinate complex of 2,6-bis[1-((2-imidazol-4-ylethyl)imino)ethyl]pyridine ((imidH)$_2$DAP) has been studied in CD_3CN by dynamic NMR line-broadening techniques. The rate constant, k'_{22} is 1.31 x 10^4 M^{-1} s^{-1} at 25°C and an ionic strength of 22.3 mM (Me_4NBF_4). Correction for ion pairing gives k^{∞}_{22} = 2.8 x $10^4 M^{-1}$ s^{-1} at μ = 38 mM and 25°C, which is a factor of 10 greater than that for the $[Cu((py)_2DAP)]^{n+}$ analogue. With the use of these two self-exchange rate constants, the Marcus cross relationship accurately predicts the measured cross-exchange rate constant. Transfer of the ligand from $[Cu^{I}((py)_2DAP)]^{+}$ to $[Zn^{II}(CH_3CN)_6]^{2+}$ at μ = 20 mM was investigated at 25°C in CH_3CN by using the stopped-flow technique. With excess Zn(II), saturation kinetics were observed; this behavior is attributed to rate-limiting dissociation of the copper complex with a rate constant of 310 s^{-1}. These results are considered in evaluating the possibility of an inner-sphere mechanism of electron transfer. 33 refs., 6 figs., 3 tabs..

45701 Synthesis of the new organic metal $(ET)_2C(CN)_3$ characterization of its metal-insulator phase transition at ≈ 180 K. Beno, M.A. (Argonne National Lab., IL (USA)); Wang, H.H.; Soderholm, L.; Carlson, K.D.; Hall, L.N.; Nunez, L.; Rummens, H.; Anderson, B.; Schlueter, J.A.; Williams, J.M.; Whangbo, M.; Evain, M. *Inorganic Chemistry (USA),* 28(1): 150-154 (11 Jan 1989). DOE Contract FG05-86ER45259;W-31-109-ENG-38.

A new conducting salt $(ET)_2C(CN)_3$, the first 2:1 salt of ET (i.e., bis(ethylenedithio)tetrathiafulvalene) with a planar-triangular anion, was synthesized, and its structure was determined by single-crystal x-ray diffraction. Crystals data for $(ET)_2C(CN)_3$ are as follows: monoclinic, P2/a, Z = 2; at 125 K/298 K, a = 14.684 (8)/14.979 (7) Å, b = 6.667 (3)/6.700 (2) Å, c = 16.400 (6)/16.395 (4) Å, β = 95.13 (3)/94.80 (3)°, and V_c = 1599 (1)/1639.7 (9) Å^3. The electrical conductivity of this salt as a function of temperature shows that it undergoes a metal-insulator phase transition at ≈ 180 K. The magnetic susceptibility measured as a function of temperature and the tight-binding band electronic structure for $(ET)_2C(CN)_3$ show that the phase transition at ≈ 180 K is a Peierls type metal-insulator transition. The band electronic structure of $(ET)_2C(CN)_3$ predicts a doubling of the b axis as a consequence of the Peierls distortion, which had been confirmed by the use of x-ray photographs of $(ET)_2C(CN)_3$ taken as a function of temperature. 26 refs., 8 figs., 1 tab..

45702 Transport in simple dense fluids. Karkheck, J. (GMI Engineering and Management Institute, Flint, MI (USA)); Stell, G.; Xu, J. *International Journal of Thermophysics (USA),* 10(1): 113-123 (Jan 1989). (CONF-880606–: 10. symposium on thermophysical properties, 20-23 Jun 1988).

A transport theory for Lennard-Jones (LJ) fluids is described. The underlying mean-field kinetic theory model the LJ potential by adding a hard-sphere core to the attractive tail of the LJ potential. The transport coefficients discussed here-shear viscosity, thermal conductivity, and self-diffusion coefficient-exhibit Enskog-like forms, but now the radial distribution function (rdf) bears explicit dependence on the LJ tail as well as on the hard-sphere core. The hard-sphere diameter is determined according to the well-known WCA method used in equilibrium statistical mechanics to mimic the LJ fluid. Hence the transport theory employs no adjustable parameters. Numerical results are compared to simulation and experimental results for many states, including saturated liquid, triple point, and dense gas. In general, a quantitatively accurate transport theory is obtained for the states considered. This represents improvement, both numerically and conceptually, over an earlier theory.

45703 Homogeneous carbon-hydrogen bond activation by electrophilic palladium(II) species. Sen, A. (Pennsylvania State Univ., University Park (USA)); Greta, E.; Oliver, T.F. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 33(3): 460-462 (Aug 1988). DOE Contract FG02-84ER13295. (CONF-8809266–: Direct conversion of methane to higher homologues, 25-30 Sep 1988).

The activation of carbon-hydrogen bonds by transition metals that leads to the selective functionalization of hydrocarbons, especially alkanes, is one of the most challenging problems in organometallic chemistry. Herein, we report our results on the palladium (II)-mediated oxidation of arenes and alkanes through a nonradical, electrophilic C-H activation pathway.

45704 Ceramic membranes for studies of reaction and diffusion. Nourbakhsh, N. (Univ. of Southern California, University Park (USA)); Webster, I.A.; Tsotsis, T.T. *American Chemical Society, Division of Petroleum Chemistry, Preprints (USA),* 33(3): 502-508 (Aug 1988). (CONF-8809227–: American Chemical Society Division of Petroleum Chemistry, 25-30 Sep 1988).

The authors present here a brief overview of our ongoing research studies of reaction and transport through porous ceramic membranes. Ceramic membranes are a new class of materials offering great promise for a wide range of catalytic and bioengineering applications. Our fundamental knowledge, however, of transport and reaction phenomena through porous membranes still remains very incomplete and currently presents a major stumbling block in the wider industrial applicability and acceptance of these materials.

45705 Electron-transfer reactions of technetium and rhenium complexes. 2. Relative self-exchange rate of the M(I)/M(II) couples $[M(DMPE)_3]^{+/2+}$, where M = Tc or Re and DMPE = 1,2-bis(dimethylphosphino)ethane. Libson, K. (Univ. of Cincinnati, OH (USA)); Woods, M.; Sullivan, J.C.; Watkins, J.W. II; Elder, R.C.; Deutsch, E. *Inorganic Chemistry (USA),* 27(6): 999-1003 (23 Mar 1988). DOE Contract W-31-109-ENG-38.

The relative rates of self-exchange of the closely related d^6/d^5 couples $[Tc(DMPE)_3]^{+/2+}$ and $[Re(DMPE)_3]^{+/2+}$ have been determined by two independent applications of the Marcus theory. (1) The rates and equilibrium constants governing the cross-reactions between $[Re(DMPE)_3]^{+}$ and $[(NH_3)_5RuL]^{3+}$ (L = 4-picoline, pyridine, and isonicotinamide) were measured in a 0.100 M LiCl and 0.001 M HCl aqueous medium and compared to equivalent data previously obtained for the reaction of $[Tc(DMPE)_3]^{+}$ with the same three Ru(III) complexes in this medium. (2) EXAFS measurements were used to obtain average Re(I)-P and Re(II)-P bond lengths for the $[Re(DMPE)_3]^{+2/2+}$ complexes, and these data were compared to equivalent data available for the $[Tc(DMPE)_3]^{+/2+}$ complexes. The difference in bond lengths, (M^{II}-P) - (M^{I}-P), is less for the Re couple than for the Tc couple (0.054 vs 0.068 Å), and within the Marcus formalism this leads directly to a structurally determined value of k_{ex}^{Re}/k_{ex}^{Tc} = 2. Thus, the kinetically observed, slightly greater rate of self-exchange of the $[Re(DMPE)_3]^{+/2+}$ couple is seen to be due entirely to the somewhat smaller structural distortions suffered by the inner coordination sphere of the Re complex during electron transfer. The absolute self-exchange rates of the $[Re(DMPE)_3]^{+/2+}$ and $[Tc(DMPE)_3]^{+/2+}$ couples are calculated to be 4 x 10^6 M^{-1} s^{-1} and 2 x 10^6 M^{-1} s^{-1}, respectively (25°C, μ = 0.10 M). 17 refs., 2 figs., 5 tabs.

45706 Ketone-like derivatization reactions of metal carbonyls. Attempts to measure the equilibrium constant for

ketalization of a carbonyl ligand in $[Re(CO)_6]^+$ by ethylene glycol. Andrews, M.A. (Brookhaven National Lab., Upton, NY (USA)); Myles, W.L. *Inorganic Chemistry (USA),* 27(6): 1118-1120 (23 Mar 1988). DOE Contract AC02-76CH00016.

In order to determine whether the inability to ketalize simple metal carbonyls such as $W(CO)_6$ and $Fe(CO)_5$ with alcohols under typical neutral or acidic conditions was a kinetic or thermodynamic problem, the reaction was approached from the reverse direction. Cationic complexes such as $[Re(CO)_6]^+$ for which the forward and reverse kinetics were expected to be more favorable were also studied. It is concluded from the slow kinetics and unfavorable equilibrium constant observed here for ketalization of a metal carbonyl that it will be difficult to achieve practical carbon monoxide activation by this type of reaction. 17 refs.

45707 Anomalous odd- to even-mass isotope ratios in resonance ionization with broad-band lasers. Fairbank, W. M., Jr. (Department of Physics, Colorado State University, Fort Collins, Colorado 80523 (US)); Spaar, M. T.; Parks, J. E.; Hutchinson, J. M. R. *Physical Review [Section] A: General Physics (USA),* 40(4): 2195-2198 (15 Aug 1989).

The response of even- and odd-mass isotopes is found to be very different in several schemes for resonance ionization of Mo and Sn, even when the laser linewidth is greater than the span of the hyperfine structure and isotope shifts.

45708 Theory of resonant ionization by broad-band radiation in the determination of isotopic abundances. Lambropoulos, P. (Department of Physics, University of Southern California, Los Angeles, California 90089-0484 (US)); Lyras, A. *Physical Review [Section] A: General Physics (USA),* 40(4): 2199-2202 (15 Aug 1989).

We present a theory for resonant ionization by broad-band laser radiation with emphasis on the role of laser bandwidth. It is shown that under certain conditions, often encountered in experiments of this type, the amount of ionization will depend on an intricate interplay between atomic and radiation parameters. The theory is discussed in the context of an application to Sn, which enables us to provide quantitative comparison with recent experimental data.

45709 Synthesis and structures of bimetallic titanium and chromium carbene complexes of the type $Cp_2Ti(Cl)O(CH_3)CCr(CO)_5$. Anslyn, E.V. (California Institute of Technology, Pasadena (USA)); Santarsiero, B.D.; Grubbs, R.H. *Organometallics (USA),* 7(10): 2137-2145 (Oct 1988).

Insertion reactions are some of the most common and important reactions in organometallic chemistry. Aside from being mechanistically interesting, they have proven useful in organic synthesis and have been postulated in catalytic cycles. A subset of the broad group of insertion reactions is the insertion of carbon monoxides of group VIB metal carbonyl complexes into early-transition-metal alkyl, aryl and hydride bonds. Although the coupling of metal alkylidenes with metal carbonyl complexes is rare in monometallic systems, such coupling is frequently postulated in heterogeneous Fischer-Tropsch systems to yield surface-bound ketene fragments. The formation of bound ketene in bimetallic and cluster complexes has been documented. Herein the authors report the coupling of titanocene methylidene with $Cr(CO)_6$ to yield a titanocene ketene complex.

45710 Reactions of disubstituted alkanes with a nickel(I) macrocycle. Ram, M.S. (Iowa State Univ., Ames (USA)); Bakac, A.; Espenson, J.H. *Inorganic Chemistry (USA),* 27(23): 4231-4235 (16 Nov 1988). DOE Contract W-7405-ENG-82.

The reactions of disubstituted alkanes, $X(CH_2)_nY$ (X, Y = Cl, Br, I, OH, OTs), with the cationic macrocyclic ion (1R,4S,8R,11S)-(1,4,8,11S)-(1,4,8,11-tetramethyl-1,4,8,11-tetraazacyclotetradecane)nickel(I), abbreviated Ni(tmc)$^+$, are characterized by kinetic accelerations compared to the rates for the monohalides, most noticeably for the smaller molecules, n = 2,3. No transient organonickel species is detected for any vicinal disubstituted alkane, and the alkene is formed quantitatively. This is attributed to a reductive elimination reaction between Ni(tmc)$^+$ and the radical $\cdot CH_2CH_2OH$, known to result from the very rapid unimolecular solvolysis of the initially formed $\cdot CH_2CH_2Y$. Although $Br(CH_2)_3OH$ yields 1-propanol from the hydrolysis of the observed species (tmc)$Ni(CH_2)_3OH^+$, 1,3-disubstituted propanes (X, Y = Br, Cl, OTs) form cyclopropane exclusively. A rapid unimolecular reaction of (tmc)$Ni(CH_2)_3Y^+$ appears responsible. The 1,4-disubstituted alkanes yield (tmc)$Ni(CH_2)_4Y^+$ deficient Ni(tmc)$^+$, but ethylene is formed rapidly and quantitatively in the presence of even a catalytic concentration of Ni(tmc)$^+$ (with Y = Br, I and to some extent Y = Cl). Similarly, (tmc)$NiCH(CH_3)(CH_2)_3Y^+$ forms a 1:1 mixture of ethylene and propene (Y = Br, I) when Ni(tmc)$^+$ is present and otherwise hydrolyzes to 1-Y pentane. Alkene formation from 1,4-disubstituted alkanes is attributed to the reaction of (tmc)$Ni(CH_2)_4Y^+$ with Ni(tmc)$^+$, producing a species (tmc)$Ni(CH_2)_4^{+}$ that yields ethylene and regenerates Ni(tmc)$^+$. 36 refs., 3 tabs.

45711 Synthesis, crystal structure, electrical properties, and band electronic structure of bis(1,3-propanediyldithio)tetrathiafulvalenium tetraiodoindate(III), $(BPDT\text{-}TTF)_3(InI_4)_2$. Geiser, U. (Argonne National Lab., IL (USA)); Wang, W.H.; Schlueter, J.; Chen, M.Y.; Kini, A.M.; Kao, I.H.C.; Williams. J.M.; Whangbo, M.H.; Evain, M. *Inorganic Chemistry (USA),* 27(23): 4284-4289 (16 Nov 1988). DOE Contract W-31-109-ENG-38;FG05-86ER45259.

A 3:2 salt $(BPDT\text{-}TTF)_3(InI_4)_2$ was obtained by electrocrystallization and its structure was determined by single-crystal x-ray diffraction (triclinic, space group $P\bar{1}$, a = 7.403 (2) Å, b = 9.170 (2) Å, c = 25.883 (7) Å, α = 89.29 (2)°, β = 96.34 (2)°, γ = 92.83 (2)°, V = 1774.2 (8) Å^3, Z = 1). Analysis of the C=C and C—S bond lengths in the PT (i.e., BPDT-TTF) molecules suggest that this salt consists of donor molecules PT in two different oxidation states (i.e., BPDT-TTF$^+$ and BPDT-TTF$^{0.5+}$). This oxidation assignment is consistent with the authors ESR measurements and band electronic structure calculations. The $(BPDT\text{-}TTF)_3(InI_4)_2$ salt is a semiconductor at room temperature and below, which can be rationalized in terms of electron localization in the stacks of BPDT-TTF$^+$ cations and the electronic instability associated with the well-nested Fermi surface for the layers of $(BPDT\text{-}TTF)_2^+$ dimers. Preliminary x-ray diffraction experiments indicate that $(BPDT\text{-}TTF)_3(TlI_4)_2$ is isostructural with $(BPDT\text{-}TTF)_3(InI_4)_2$. 28 refs., 7 figs., 3 tabs.

45712 Kinetic and thermodynamic stabilities of the geometric isomers of $(R_3P)_2Ru(CO)_2Cl_2$ and $(R_3P)_3Ru(CO)Cl_2$ complexes. Krassowski, D.W. (Univ. of Nevada, Reno (USA)); Nelson, J.H.; Brower, K.R.; Hauenstein, D.; Jacobson, R.A. *Inorganic Chemistry (USA),* 27(23): 4294-4307 (16 Nov 1988).

A series of ruthenium(II) complexes of the type $RuCl_2(CO)_2P_2$ (P = Bzl_3P, Ph_3P, Ph_2MeP, $PhMe_2P$, Me_3P) have been prepared and characterized by elemental analyses, physical properties, infrared spectroscopy, uv-visible spectroscopy, and ^1H, $^{13}C[^1H]$ and $^{31}P[^1H]$ NMR spectroscopy. The first-formed complex, with all ligand pairs trans(ttt), thermally isomerizes in solution to produce the isomer with all ligand pairs cis (ccc). This ccc isomer further isomerizes in solution to produce the thermodynamically preferred isomer with only the phosphine ligands trans (cct). The size and basicity of the phosphine affect the isomerization rate, which increases with an increase in size and a decrease in phosphine basicity and proceeds by initial dissociation of carbon monoxide. Activation and crystal parameters for the complex are reported. The bond distance of the phosphine trans to carbon monoxide in the trans isomer (d(RuP) = 2.490 (4) Å) is longer than the other two Ru-P distances (2.403 (4) Å). The $^{31}P[H]$NMR data also suggest that this phosphine is relatively weakly bound and so this phosphine likely dissociates as the first step in the geometric isomerization. 47 refs., 11 figs., 21 tabs.

45713 Formation and molecular structure of the novel six coordinate aminoalane complex $[[(CH_3)_3Si]_2Al(NH_2)_2]_3Al$. Janik, J.F. (Univ. of New Mexico, Albuquerque (USA)); Duesler, E.N.; Paine, R.T. *Inorganic Chemistry (USA),* 27(24): 4335-4338 (30 Nov 1988). DOE Contract FG05-86ER75294.

Reaction of $[(CH_3)_3Si]_3Al{\cdot}O(C_2H_5)_2$ and NH_3 in a 1:2 ratio results in the formation of $[[(CH_3)_3Si]_2Al(NH_2)_2]_3Al$. The compound was characterized by elemental analysis, mass, infrared, and NMR spectroscopic data, and a single-crystal x-ray diffraction analysis. The compound crystallizes in the monoclinic space group C2/c with a = 13.981 (2) Å, b = 14.064 (2) Å, c = 23.025 (2) Å, β = 106.2 (1)°, Z = 4, V = 4,347 (1) Å^3, and ρ = 0.98 g cm^{-3}. Least-squares refinement gave R_F = 9.56% and R_{wF} = 7.37% on 2,504 reflections with $F \geq 3\sigma(F)$. The molecular structure shows a central six-coordinate,

pseudooctahedral Al atom bonded to three bidentate aminosilyl aluminum ligands, $[[(CH_3)_3Si]_2(NH_2)_2^-]$. The average central Al-N(H)$_2$ distance is 2.020 (5) Å, and the average Al-N(H)$_2$ distance in the ligands units is 1.932 (5) Å. Pyrolysis of this molecular species provides a mixture of AlN and SiC. 11 refs., 1 fig., 3 tabs.

45714 (Pentafluoro-λ^6-sulfanyl)(fluorosulfonyl)ketene. Winter, R. (Portland State Univ., OR (USA)); Gard, G.L. *Inorganic Chemistry (USA),* 27(23): 4329-4331 (16 Nov 1988). DOE Contract FG21-88MC25142.

A new ketene $F_5SC(SO_2F)=C=O$ has been synthesized, and it is predicted that since SF_5-containing sulfones are effective precursors to a number of derivatives potentially useful as acid electrolytes, surface-active agents, and ion-exchange resins this new ketene and its derivatives will also serve in this role. The preparation of the ketene is described in detail, and the ir and ^{19}F NMR spectra of the SF_5-containing sulfones are discussed. 14 refs.

45715 Concurrent and reversible changes of color and of phase in an aqueous solution of the (2,6-pyridinedicarboxylato)chloroplatinate(II) complex. Spectroscopic and crystallographic studies of the discrete monomer and evidence of a stacked polymer. Zhou, X. (Iowa State Univ., Ames (USA)); Kostic, N.M. *Inorganic Chemistry (USA),* 27(24): 4402-4408 (30 Nov 1988). DOE Contract W-7405-ENG-82.

The title complex, $[Pt(dipic)Cl]^-$, was prepared in a reaction between dipicolinate salts and $[PtCl_4]^{2-}$. The variation in temperature or in concentration of its aqueous solution causes two changes - of color and of phase - which are sudden concurrent, and reversible. At higher temperatures or lower concentrations the complex is yellow and monomeric, whereas at lower temperatures or attempted higher concentrations it is red and probably polymeric. The red form is microcrystalline and probably composed of stacked $[Pt(dipic)Cl]^-$ units. Unlike other square-planar complexes that form stacks, the yellow from of $[Pt(dipic)Cl]^-$ remains monomeric over a wide range of concentration and temperature until the sudden onset of the supposed polymerization. The nucleation and growth of the red from are easily monitored owing to the concomitant color change. The crystal structure for the monomeric salt is reported. The uv-vis spectrum of the red K[Pt(dipic)Cl] in the solid state contains a low-energy absorption band diagnostic of the stacking. This band disappears when the red polymer dissolves in water to give a yellow monomeric solution. The $[Pt(dipic)Cl]^-$ salts, like thermochromic materials, hold promise as temperature indicators. 62 refs., 4 figs., 5 tabs.

45716 Synthetic and structural studies on the formation of a tetradecametallic yttrium oxide alkoxide chloride complex: An example of how molecular yttrium oxygen frameworks from extended arrays. Evans, W.J. (Univ. of California, Davis (USA)); Sollberger, M.S. *Inorganic Chemistry (USA),* 27(24): 4417-4423 (30 Nov 1988).

YCl_3 reacts with 2 equiv of $NaOCMe_3$ in THF to from $Y_3(OCMe_3)_7Cl_2(THF)_2$ (1) in 80% yield. The yttrium atoms in this molecule form a triangle that has double bridging alkoxide groups along each edge, a μ_3-$OCMe_3$ group on one side of the Y_3 plane, and a μ_3-Cl ligand on the other side. One metal is coordinated to a terminal chloride ion and a terminal alkoxide group. Each of the other metals is coordinated to a terminal alkoxide group and a molecular of THF. Both chloride ions lie on the same side of the Y_3 plane as the two THF ligands. In toluene under nitrogen over a period of 2 weeks, 1 converts to Y_{14}-$(OCMe_3)_{28}Cl_{10}O_2(THF)_4$ (2) in quantitative yield. 2 is comprised of four trimetallic $Y_3(\mu_3\text{-}OR)(\mu_3\text{-}X)(\mu\text{-}Z)_3$ units (where X = Cl, O; Z = Cl, $OCMe_3$) that have structures similar to the $Y_3(\mu\text{-}OR)(\mu_3\text{-}Cl)(\mu\text{-}OR)_3(OR)_3Cl(THF)_2$ structure of 1. The four trimetallic subunits in 2 are connected by two μ-Cl ions, a μ_4-O ion and a $[(\mu\text{-}OR)_2Y(\mu\text{-}Cl)]_2$ group. Complex 2 is a dimer, $[[Y_3(\mu_3\text{-}OR)(\mu_3\text{-}Cl)(\mu\text{-}OR)_3(OR)_3(THF)_2](\mu\text{-}Cl)[Y_3(\mu_3\text{-}OR)(\mu\text{-}OR)_2(\mu\text{-}Cl)(OR)_2](\mu_4\text{-}O)[(\mu\text{-}OR)_2Y(\mu\text{-}Cl)]]_2$, which contains a center of inversion. The crystal structures of 1 and 2 are reported. 52 refs., 3 figs., 3 tabs.

45717 Valence electronic structure of bis(pyrazolyl)-bridged iridium dicarbonyl dimers. Electronic effects of 3,5-dimethylpyrazolyl substitution on metal-metal interactions. Lichtenberger, D.L. (Univ. of Arizona, Tucson (USA)); Copenhaver, A.S.; Gray, H.B.; Marshall, J.L.; Hopkins, M.D. *Inorganic Chemistry (USA),* 27(24): 4488-4493 (30 Nov 1988). DOE Contract AC02-80ER10746.

The He I valence photoelectron spectra of $[Ir(\mu\text{-pyrazolyl})(CO)_2]_2$, $[Ir(\mu\text{-3-methylpyrazolyl})(CO)_2]_2$, and $[Ir(\mu\text{-3,5-dimethylpyrazolyl})(CO)_2]_2$ have been obtained. These complexes may be viewed as two square-planar d^8 iridium centers held together by two bridging pyrazolyl ligands to form a six-membered Ir-(N-N)$_2$-Ir ring. The ring is in a boat conformation with the iridium atoms positioned at the bow and stern such that interaction is possible between the filled d_{z^2} orbitals from each metal center. The 3,5-dimethylpyrazolyl complex is active as a hydrogenation catalysts while the other related complexes are not. It is found here that there is substantial interaction between the d_{z^2} atomic orbitals of the two iridium centers, and the ionization corresponding to the Ir-Ir antibonding d_{z^2}-d_{z^2} interaction is the lowest energy ionization band of these complexes. This ionization is cleanly separated from the other ionizations of the complexes. Of particular interest is the broad and unusual asymmetry found in the band profile of the initial ionization. The energy of the first ionization band is very sensitive to the methyl substitutions on the pyrazolyl groups. The sensitivity of this ionization to methyl substitution (and in turn the change in reaction chemistry between these complexes) is due more to the electronic inductive effects of the methyl group substitutions than to changes in geometry and splitting of the bonding and antibonding combinations of the metal d_{z^2} orbitals. 28 refs., 7 figs., 7 tabs.

45718 Heterodyne laser spectroscopy system. Wyeth, R.W.; Paisner, J.A.; Story, T. To Dept. of Energy, Washington, DC. USA Patent 4,817,101. 28 Mar 1989. Filed date 26 Sep 1986. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A heterodyne laser spectroscopy system utilizes laser heterodyne techniques for purposes of laser isotope separation spectroscopy, vapor diagnostics, processing of precise laser frequency offsets from a reference frequency and the like, and provides spectral analysis of a laser beam.

45719 Method for the preparation of novel polyacetylene-type polymers. Zeigler, J.M. To Dept. of Energy, Washington, DC. USA Patent 4,812,520. 14 Mar 1989. Filed date 9 Nov 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

Polymerization of acetylenic monomers is achieved by using a catalyst which is the reaction product of a tungsten compound and a reducing agent effective to reduce W(VI) to W(III) and/or (IV), e.g., WCl_6.(organo-Li, organo-Mg or polysilane). The resultant silylated polymers are of heretofore unachievable high molecular weight and can be used as precursors to a wide variety of new acetylenic polymers by application of substitution reactions.

45720 Method of removing nitrogen monoxide from a nitrogen monoxide-containing gas using a water-soluble iron ion-dithiocarbamate, xanthate or thioxanthate. Liu, D.K.; Chang, S.G. To Dept. of Energy, Washington, DC. USA Patent 4,810,474. 7 Mar 1989. Filed date 25 Aug 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A method is described of removing nitrogen monoxide from a nitrogen monoxide-containing gas, which method comprises: contacting a nitrogen oxide-containing gas with an aqueous solution of water soluble organic compound-iron ion chelate.

4004 Electrochemistry

45721 (CONF-881054--Vol.1, pp. 155-166) **Concentrated hazardous organic waste destruction by electrochemical oxidation.** Molton, P.M. (Battelle Pacific Northwest Lab., Richland, WA (USA)); Fassbender, A.G.; Nelson, S.A.; Cleveland, J.K. Analysas Corp., Oak Ridge, TN (USA). 1988. DOE Contract AC06-76RL01830. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Concentrated organic compounds typical of major hazardous waste components were subjected to anodic electrochemical oxidation (ECO) in a continuous recycle mode in the presence of a molar nickel nitrate (Ni(II)) electron carrier in molar nitric acid. The

catholyte comprised molar nitric acid. Chlorinated compounds such as chlorobenzene, chloroform, perchloro- and trichloroethylene were readily oxidized to a mixture of carbon dioxide and oxygen (the latter from water electrolysis). ECO conversion of phenol rapidly led to insoluble tar formation by a free radical coupling mechanism. The lack of water solubility of most of the compounds examined did not affect the oxidation per se, although it may have contributed to a lower oxidation rate than was previously observed for hexone (MIBK, methyl isobutyl ketone) in solution. A conceptual design for a commercial ECO-system is being developed based on these laboratory results, and work is continuing on the oxidation of mixtures of hazardous materials often found at waste sites. The technique offers promise as a low-temperature and pressure method for waste destruction, especially for concentrated organic wastes.

45722 Measuring surfactant concentration in plating solutions. Bonivert, W.D.; Farmer, J.C.; Hachman, J.T. To Dept. of Energy, Washington, DC. USA Patent 4,812,210. 14 Mar 1989. Filed date 16 Oct 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

An arrangement for measuring the concentration of surfactants in a electrolyte containing metal ions includes applying a DC bias voltage and a modulated voltage to a counter electrode. The phase angle between the modulated voltage and the current response to the modulated voltage at a working electrode is correlated to the surfactant concentration.

4005 Photochemistry

Refer also to citation(s) 46613

45723 (CONF-881054–Vol.1, pp. 143-154) **Solar photochemical process for destroying organics in water.** Holmes, J.T. (Sandia National Labs., Albuquerque, NM (USA)); Haslund, C.A. Analysas Corp., Oak Ridge, TN (USA). 1988. DOE Contract AC04-76DP00789. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Recent scientific literature indicates the potential benefits of using photocatalytic oxidation reactions for the destruction of organic contaminants in water. The processes utilize solid or dissolved photon-activated catalysts to break down low concentrations of hazardous organic chemicals into carbon dioxide and simple acids. The authors are using concentrated sunlight to study a falling-liquid-film reactor that has the following characteristics to effectively conduct these photochemical reactions. (1) The ability to utilize high solar (photon) flux densities without overheating or evaporating the fluid or contaminants. (2) Excellent interaction, in the thin film of fluid, between concentrated sunlight, catalyst and contaminants in the fluid. (3) The fluid is easily doped with reactants and solid or dissolved catalysts. (4) High water processing rates. (5) Easy process control. They investigated the maximum solar power capabilities of a pilot-scale (1m x 3.5m) falling-water-film reactor. Their thermal performance results indicate its potential as a photochemical reactor.

45724 (DOE/ER/13592–3) **Photoexcited charge pair escape and recombination: Progress report, August 1, 1986–March 1, 1989.** Braun, C.L. Dartmouth Coll., Hanover, NH (USA). Dept. of Chemistry. Mar 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER13592. Order Number DE89016739/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have studied the escape and recombination of charge pairs produced by photoexcitation of organic molecules. As in the past, this work has been directed toward the understanding of two separate but related problems: (1) What is the best (quantitative) description of the geminate charge pairs produced by photoionization of solute molecules in a low dielectric constant liquid like hexane? (2) What quantitative model describes charge pair dissociation in electron-donor-acceptor (EDA) solids in which the lowest energy excited states have charge-transfer (CT) character? Over the past two and one-half years, progress has been more rapid in the second area than in the first, but results for both types of materials will be described. Both areas involve charge pair dissociation and recombination in organic molecular materials, but they differ in that liquids like hexane are very poor electron acceptors. Thus in hexane, photoionization of a solute M generally requires a photon energy substantially above that of the lowest excited singlet or triplet state of M. Thus those neutral states play no role in ionization (other than as intermediates in multiphoton ionization or as products in charge recombination.) 13 refs., 3 figs.

45725 (LA-UR–89-2337) **Time-resolved flourescence measurements of KrF emission produced by vacuum ultraviolet photolysis of KrF_2 mixtures.** Tiee, J.J.; Quick, C.R.; Hsu, A.H.; Hof, D.E. Los Alamos National Lab., NM (USA). 1989. 24p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8907130–1: 9. vacuum ultraviolet radiation conference, 17-21 Jul 1989). Order Number DE89015267/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Vacuum ultraviolet (VUV) light radiation was used to produce electronically excited KrF excimers (in D-, B- and C-states) by the photolysis of KrF_2 and F_2/Kr mixtures at various excitation wavelengths. The excited KrF photoproduct quantum yield was measured over the excitation wavelength range of 120 to 200 nm, and a quantum efficiency of 0.45 was estimated at the peak absorption wavelength of 159 nm for KrF_2. The collision-free fluorescence lifetime of the B-X transition near 248 nm was determined to be 9.9 $\pm$ 0.6 ns when the KrF_2 was excited with the 159 nm light. Near gas kinetic rate constants were measured for the quenching of KrF B-X emission by KrF_2 and CO_2. Using the threshold energy needed for observing excited KrF photofragments, an upper bound for the bond dissociation energy of KrF_2 was determined to be 1.03 $\pm$ 0.1 eV. 14 refs., 8 figs.

45726 (SAND–89-0482C) **Consequence of condensed-phase formation in transient burning of $TiH_x/KClO_4$ in a closed system.** Razani, A.; Shahinpoor, M.; Hingorani-Norenberg, S.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909113–3: 14. international pyrotechnics seminar, 18-22 Sep 1989). Order Number DE89013922/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Transient burning of $TiH_x/KClO_4$ in a closed system is formulated including the effect of condensed species. Thermodynamic properties are evaluated using both BLAKE and TIGER computer codes. Three different equations of state for gaseous species are used and their effect on the burning rate is evaluated. For more accurate transient burning analysis, a pressure dependent covolume for gaseous species is generated. The effect of pressure dependent covolume as well as the condensed species on transient burning is evaluated. Both parameters are found to be important when the burning rate at high loading densities in a closed system is considered. At high loading densities, condensed species become important not only because of the their effect on thermodynamic properties but also due to the volume occupied by these species. 11 refs., 2 figs., 2 tabs.

45727 (SAND–89-0871C) **Photochemically-driven biomimetic oxidation of alkanes and olefins.** Shelnutt, J.A.; Trudell, D.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890902–5: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89011536/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A photochemical reaction for oxidation of hydrocarbons that uses molecular oxygen as the oxidant is described. A reductive photoredox cycle that uses a tin(IV)- or antimony(V)-porphyrin photosensitizer generates the co-reductant equivalents required to activate oxygen. This "artificial" photosynthesis system drives a second catalytic cycle, mimicking the cytochrome P_{450} reaction, which oxidizes hydrocarbons. An iron (III)- or manganese(III)-porphyrin is used as the hydrocarbon-oxidation catalyst. Methylviologen can be used as a redox relay molecule to provide for electron-transfer from the reduced photosensitizer to the Fe or Mn porphyrin, but appears not to enhance efficiency of the process. The system is long-lived and may be used in time-resolved spectroscopic studies of the photo-initiated reaction to determine reaction rates and intermediates. 21 refs., 2 figs., 1 tab.

4006 Radiation Chemistry

Refer also to citation(s) 45565, 46242

45728 (IAEA-TECDOC–506, pp. 80-91) **Computer experiment and radiation data for liquid water and water vapor irradiated by fast electrons.** Kaplan, I.G. (L. Ya. Karpov Inst. of Physical Chemistry, Moscow (USSR)). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The radiation data obtained in computer simulation of the irradiation process by fast electrons of the water in liquid and gas phases are presented. Among them are yields of excited and ionized states, ranges and stopping power, yields of primary (at $t \sim 10^{-11}$s) radiolysis products. The specific features of liquid phase and its influence on radiation data are discussed. (author). 36 refs, 3 figs, 7 tabs.

45729 (SKB-TR–88-27) **On the formation of a moving redox-front by α-radiolysis of compacted water saturated bentonite.** Eriksen, T.E.; Ndalamba, P. Swedish Nuclear Fuel and Waste Management Co., Stockholm (Sweden). Dec 1988. 24p. Order Number DE89912023/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The formation of an expanding volume containing the radiolytically formed oxidants H_2O_2 and O_2 has been studied in α-irradiated compacted water saturated bentonite (rho = 2.12 gxcm^{-3}). The G-values (0.67+-0.05), (0.64+-0.07) for H_2O_2 and O_2 respectively are in fair agreement with the corresponding G-values obtained in experiments with synthetic ground water. From the leaching of γ-irradiated bentonite it is concluded that only a fraction of the Fe^{2+} content is easily accessible as scavenger for the radiolytically formed oxidants. (orig.).

4007 Radiochemistry and Nuclear Chemistry

Refer also to citation(s) 45628, 45629, 45749, 46184, 46205

45730 (AD-A–207857/4/XAB) **Synthesis of radiolabeled chemical agents/precursors. Final summary report, 1 March 1984-30 September 1986.** Duncan, W.P.; LaMontagne, M.P.; Uchic, J.T.; Rotert, G.A.; Ebert, D.A. Chemsyn Science Labs., Lenexa, KS (USA). 31 Mar 1989. 64p. Available from NTIS, PC A04/MF A01.

A total of eight compounds were prepared under the subject contract. These are: (methyl-^{3}H) and (methyl-^{14}C)GB, (methyl-^{3}H) and (methyl-^{14}C)GD, (methyl-^{3}H) and (methyl-^{14}C)VX, (UL-^{3}H) and (UL-^{14}C)mustard. In addition to the above, and toward the end of the contract period, attempts were made to prepare the four optical isomers of soman (GD). Although this work could not be completed prior to the expiration of the contract, significant progress was made. Conditions were developed which afforded material of reasonable (> 90%) optical purity. However, a need exists to optimize the yields which, to date, are quite low (< 20%).

45731 (EUR–11526) **About the reaction between uranium-americium mixed oxides and sodium.** Mayer, K. Commission of the European Communities, Luxembourg (Luxembourg). 1988. 109p. (In German). Available from NTIS (US Sales Only), PC A06/MF A01.

The recycling and fission of the highly toxic minor actinides neptunium and americium is only possible in a liquid metal cooled fast breeder reactor, for nuclear physical reasons. The present work is part of a research program dealing with the fuel-coolant interaction. Fuel pellets with equal parts of americium and uranium and varying oxygen-metal ratio were investigated. A behaviour comparable to that of uranium-plutonium mixed oxides was suggested as a first approach. The reaction of sodium with $(U_{0.5}Am_{0.5})O_{2-x}$ results in a complete desintegration of the sintered pellet whereas (U, Pu)O_{2-x} pellets show a small increase in volume. A first explanation of the strong reaction of uranium-americium mixed oxides compared to (U, Pu)O_{2-x} or (U, Np)O_{2-x} could be provided by the less negative oxygen potential of the former. Ternary and polynary oxides which are possible products of the fuel-coolant reaction were prepared and characterised by X-ray diffraction. Their oxygen potentials were measured using a solid state e.m.f. cell. Neither Na_2AmO_3 nor Na_3AmO_4 can coexist with sodium metal. The measured ΔG_{O2} values of the Am(IV) and Am (V)-compounds are much higher than those of the sodium uranates(VI) or sodium neptunates(VI). Only Na_2O seems to be likely as product of the fuel-coolant interactions. It could be determined in reacted samples by X-ray diffraction. The relatively high oxygen potentials of $(U_{0.5}Am_{0.5})O_{2-x}$ that are responsible for the reaction could be explained by a binding model which is based on an americium valency state of + 3 and U^{5+}. The existence of both valency states could be proved by XPS measurements. Due to the similar behaviour of neptunium and uranium the problems that are expected for the recycling of Np are much smaller than for americium.

45732 (INIS-BR–1606) **Separation of ^{99}Mo from ^{132}Te using thiourea as complexing agent. Application to the separation of ^{99}Mo from the fission products.** Mestnik, S.A.C. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1987. 101p. (In Portuguese). Order Number DE89636142/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

A radiochemical method to isolate ^{99}Mo from ^{132}Te both produced in the fission of ^{235}U has been developed. The method is based on the formation of a cationic complex of tellurium with thiourea in acid medium wich is retained (98.7+-0.5) % on a cation exchange resin (Dowex 50W-X8, 100-200 mesh) wile (99.8+-0.05)% ^{99}Mo passes through it, due to the non formation of such complex in the same experimental conditions. The radiochemical purity of the separated ^{99}Mo verified by using gamma spectrometry was found to be suitable for the preparation of ^{99}Mo-^{99m}Tc generators. The retention of ^{99}Mo on an alumina column as function of pH was investigated. The best pH range for this purpose was found to be between 4.0-4.5. Yellow crystals with melting point of 115^{0}C were formed when non-irradiated tellurium reacted with thiourea. Elemental analysis, ultra-violet and infra-red absorption spectrophotometry as well as thermogravimetry were used to characterize the complex formed. In the studies made in order to characterize the compound it has been observed: 1. the most probable chemical composition of the complex studied is $[Te(SCN_2H_4)_4]$ $(SO_4)_2$; 2. the coordination takes place between tellurium and sulphur atoms; 3. the maximum absorption in the ultra-violet region occurs near 310nm. The thermogravimetric curves obtained allowed to propose the concerned thermodecomposition mechanism. (author).

45733 (INIS-SU–104/A, pp. 217-218) **Infrared spectra of UF_6, WF_6 and MoF_6 molecules in solutions of loquified rare gases.** Nabiev, Sh.Sh. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Inst. Atomnoj Ehnergii); Ushakov, V.P. Moskovskij Gosudarstvennyj Univ., Moscow (USSR); AN SSSR, Moscow (USSR). Otdelenie Obshchej i Tekhnicheskoj Khimii. 1988. (In Russian). (CONF-881298–: 4. All-Union conference on low temperature chemistry, 21-23 Dec 1988). In *4. All-union conference on low temperature chemistry. Summaries of reports.* Order Number DE89012195/JAW. Available from NTIS (US Sales Only), PC A11/MF A01; INIS.

Short Communication

45734 (INIS-SU–107/A, pp. 21) **Quantitative estimation methods of extractant basicity using NMR spectroscopy.** Laskorin, B.N. (Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR)); Skorovarov, D.I.; Lagutenkov, V.A.; Meshcheryakov, N.M.; Mikheev, M.V.; Lekanova, T.V. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.

Short Communication

45735 (INIS-SU–107/A, pp. 35-36) **^{99}Tc and ^{23}Na NMR in polycrystalline sodium and silver pertechnetates.** Tarasov, V.P. (AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii); Privalov, V.I.; German, K.Eh. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.

Short Communication

45736 (INIS-SU–110/A) **Radiopharmaceuticals in oncology. Collection of scientific papers.** Tarasov, N.F.; Korsunskij, V.N. (eds.). Institut Biofiziki, Moscow (USSR). 1988. 188p. (In Russian). Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Individual papers in scope for the data base are processed separately. (DLC)

45737 (IPEN-PUB–248) **Separation of ^{99}Mo from ^{132}Te using thiourea as complexing agent. Application to the separation of ^{99}Mo from the fission products.** Mestnik, S.A.C.; Silva, C.P.G. da. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Feb 1989. 29p. (In Portuguese). Order Number DE89636143/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A radiochemical method to isolate ^{99}Mo from ^{132}Te both produced in the fission of ^{235}U has been developed. The methods is based on the formation of a cationic complex of tellerium with thiourea in acid medium which is retained (98.7 +– 0.5)% on a cation exchange resin (Dowex 50W-X8, 100 - 200 mesh) while (99.8 +– 0.05)% ^{99}Mo passes through it, due to the non formation of such complex in the same experimental conditions. The radionuclidic purity of the separated ^{99}Mo verified by using gamma spectrometry was found to be suitable for the preparation of ^{99}Mo - ^{99}sup (m)Tc generators. The retention of ^{99}Mo on an alumina column as function of ph was investigated. the best pH range for this purpose was found to be between 4.0 - 4.5. the ^{99}Mo - ^{99m}Tc generator was prepared. the elution of^{99m}Tc was carried out with physiologic saline solution. The radionuclidic purity of the eluate was found suitable and the product can be used for Nuclear Medicine applications. (author).

45738 (MLM–3527, pp. 34-46) **Calculations in plutonium chemistry: Determination of plutonium oxidation state distributions.** Silver, G.L. Monsanto Research Corp., Miamisburg, OH (USA). Mound. 29 Jul 1988. In *Mound activities in chemical and physical research, July-December 1987.* Order Number DE89015149/JAW. Available from NTIS, PC A03/MF A01.

An alternative method is presented for determining equilibrium oxidation state distributions for plutonium. The basis of the program is a uniplex routine. The virtues of the program are that it is easy to write and that it works for most situations that typically arise in the laboratory. Convergence is not guaranteed, however. Therefore, purists may prefer to use the characteristic equation to prepare programs using algorithms they consider to be more reliable.

45739 **Potential applications of arsenic radioisotopes.** Emran, A.M. (Univ. of Texas Health Science Center, Houston (USA)); Phillips, D.R. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809278–: American Chemical Society Division of Nuclear Chemistry and Technology, 25-30 Sep 1988).

Positron Emission Tomography (PET) is passing its developmental stage and is showing an increasing move from being an experimental field into the actual use as a clinical tool. This is also associated with increasing demand for radioisotopes and need for development of new ones with emphasis on generator systems to overcome the difficulty of having to acquire a cyclotron. The availability of several radioisotopes of arsenic has allowed for possible utilization of such radioisotopes in various applications in therapy and diagnostic imaging. Several groups have described their concepts behind the use of radioarsenic isotopes, the development of the nuclear chemistry and generation of such isotopes as well as the radiochemistry of organoarsenical compounds. Of the seventeen known isotopes of arsenic, five are positron emitters of which Arsenic-72 is a good candidate for application with PET. We shall discuss our development of radioarsenic isotopes, synthesis of organoarsenic compounds and potential applications.

45740 **Mercuric acetate phenyl maleimide useful for preparing radiohalogenated maleimides.** Srivastava, P.C. To Dept. of Energy, Washington, DC. USA Patent 4,812,577. 14 Mar 1989. Filed date 12 Feb 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A mercuric maleimide is utilized as a pharmaceutical kit for preparing radiohalogenated maleimides.

4008 Combustion, Pyrolysis, and High-temperature Chemistry

Refer also to citation(s) 45110, 45853

45741 (N–89-22053) **Gas density effect on dropsize of simulated fuel sprays.** Ingebo, R.D. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 14p. (NASA-TM–102013;E–4725;NAS–1.15:102013;CONF-8907118–: 25. American Society of Mechanical Engineers joint propulsion conference, 10-13 Jul 1989). Available from NTIS, PC A03/MF A01.

Two-phase flow in pneumatic two-fluid fuel nozzles was investigated experimentally to determine the effect of atomizing-gas density and gas mass-flux on liquid-jet breakup in sonic-velocity gas-flow. Dropsize data were obtained for the following atomizing-gases: nitrogen; argon; carbon dioxide; and helium. They were selected to cover a gas molecular-weight range of 4 to 44. Atomizing-gas mass-flux ranged from 6 to 50 g/sq cm-sec and four differently sized two-fluid fuel nozzles were used having orifice diameters that varied from 0.32 to 0.56 cm. The ratio of liquid-jet diameter to SMD, D sub o/D sub 32, was correlated with aerodynamic and liquid-surface forces based on the product of the Weber and Reynolds number, We*Re, and gas-to-liquid density ratio, rho sub g/rho sub l. To correlate spray dropsize with breakup forces produced by using different atomizing-gases, a new molecular-scale dimensionless group was derived. The derived dimensionless group was used to obtain an expression for the ratio of liquid-jet diameter to SMD, D sub o/D sub 32. The mathematical expression of this phenomenon incorporates the product of the Weber and Reynolds number, liquid viscosity, surface tension, acoustic gas velocity, the RMS velocity of gas molecules, the acceleration of gas molecules due to gravity, and gas viscosity. The mathematical expression encompassing these parameters agrees well with the atomization theory for liquid-jet breakup in high velocity gas flow. Also, it was found that at the same gas mass-flux, helium was considerably more effective than nitrogen in producing small droplet sprays with SMD's in the order of 5 micrometers.

45742 (N–89-22837) **Inviscid spatial stability of a compressible mixing layer. Part 2: The flame sheet model. Final report.** Jackson, T.L.; Grosch, C.E. National Aeronautics and Space Administration, Hampton, VA (USA). Inst. for Computer Applications in Science and Engineering. Mar 1989. 33p. (NASA-CR–181815;NAS–1.26:181815;ICASE–89-18-PT-2). Available from NTIS, PC A03/MF A01.

The results of an inviscid spatial calculation for a compressible reacting mixing layer are reported. The limit of infinitive activation energy is taken and the diffusion flame is approximated by a flame sheet. Results are reported for the phase speeds of the neutral waves and maximum growth rates of the unstable waves as a function of the parameters of the problem: the ratio of the temperature of the stationary stream to that of the moving stream, the Mach number of the moving streams, the heat release per unit mass fraction of the reactant, the equivalence ratio of the reaction, and the frequency of the disturbance. These results are compared to the phase speeds and growth rates of the corresponding nonreacting

mixing layer. We show that the addition of combustion has important, and complex effects on the flow stability.

45743 (NEI-DK–188) **Conditions of radiation in large boilers and furnaces. Ribbon radiation models.** Energiministeriets Energiforskningsprogram. Braendsler og forbraendingsteknik. Toerslev Jensen, P. Danmarks Tekniske Hoejskole, Lyngby (Denmark). Lab. for Varme- og Klimateknik. Feb 1989. 113p. (In Danish). Order Number DE89914645/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

Energiministeriets Energiforskningsprogram. Braendsler og forbraendingsteknik.; EFP-85.

Basic characteristics of thermal radiation and, more especially, gas radiation are examined. The aim was to establish more detailed calculation systems in connection with larger boilers and furnaces. The investigated calculation models were Hottel's and Edwards. It is concluded that a calculation model based on that recommended by Edwards was the most efficient for evaluating radiation in boilers and furnaces where steam and carbon dioxide are the primary sources of emission, but the model should be adapted and simplified before it could be utilized in computer simulation of these condition. (AB) 11 refs.

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Refer also to citation(s) 45898

45744 (CONF-8909167–2) **Autonomous mobile robot research using the HERMIES-III robot.** Pin, F.G.; Beckerman, M.; Spelt, P.F.; Robinson, J.T.; Weisbin, C.R. Oak Ridge National Lab., TN (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From IROS '89: international workshop on intelligent robots and systems: the autonomous robot and its application; 4-6 Sep 1989. Order Number DE89015916/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper reports on the status and future directions in the research, development and experimental validation of intelligent control techniques for autonomous mobile robots using the HERMIES-III robot at the Center for Engineering Systems Advanced research (CESAR) at Oak Ridge National Laboratory (ORNL). HERMIES-III is the fourth robot in a series of increasingly more sophisticated and capable experimental test beds developed at CESAR. HERMIES-III is comprised of a battery powered, onmidirectional wheeled platform with a seven degree-of-freedom manipulator arm, video cameras, sonar range sensors, laser imaging scanner and a dual computer system containing up to 128 NCUBE nodes in hypercube configuration. All electronics, sensors, computers, and communication equipment required for autonomous operation of HERMIES-III are located on board along with sufficient battery power for three to four hours of operation. The paper first provides a more detailed description of the HERMIES-III characteristics, focussing on the new areas of research and demonstration now possible at CESAR with this new test-bed. The initial experimental program is then described with emphasis placed on autonomous performance of human-scale tasks (e.g., valve manipulation, use of tools), integration of a dexterous manipulator and platform motion in geometrically complex environments, and effective use of multiple cooperating robots (HERMIES-IIB and HERMIES- III). The paper concludes with a discussion of the integration problems and safety considerations necessarily arising from the set-up of an experimental program involving human-scale, multi-autonomous mobile robots performance. 10 refs., 3 figs.

45745 (SAND–89-1180C) **Telemanaged systems.** Kelsey, J.R.; Roehrig, S.C. Sandia National Labs., Albuquerque, NM (USA). [1989]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8908111–1: 2. workshop on military robotics applications, 8-11 Aug 1989). Order Number DE89016414/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Sandia National Laboratories is developing a number of telemanaged systems. Telemanagement is a term coined to describe those systems which are neither purely autonomous nor purely teleoperated, but rather combine these two operating modes depending on the task to be performed. When the task is solely performed with a human operator in the control loop, the system is teleoperated; when the computer is the sole controller, the system operates autonomously. Most operations are a mixture of these two extremes and are termed "telemanaged." Autonomous systems perform best in a structured environment performing structured, repetitive tasks. Teleoperated systems provide the most cost-effective solution when unpredictable task must be performed in an unfamiliar or or unstructured environment. However, in most cases, autonomous systems require some human oversight, and teleoperated systems perform best with computer assistance. 1 fig.

4202 Facilities and Equipment

Refer also to citation(s) 44777, 44778, 44779, 44780, 44781, 44813, 45058, 45059, 45157, 45158, 45159, 45161, 45335, 45354, 45566, 46620, 46702, 46705, 46706, 46707, 46708, 46709, 46710, 46711, 46712, 46765

45746 (AD-A–207925/9/XAB) **Fluxons and order in long Josephson junctions. Final report, 15 November 1985-14 November 1988.** Symko, O.G. Utah Univ., Salt Lake City, UT (USA). Dept. of Physics. 24 Feb 1989. 50p. Available from NTIS, PC A03/MF A01.

Studies were made of fluxon dynamics, instabilities, and noise in long overlap-type Josephson junctions made out of of niobium-nitride and niobium. Noise and fluctuations measurements were performed in the voltage state of the junctions biased in a magnetic field. Telegraph noise was observed due to fluxon fluctuations between two energy states determined by the geometry of the junction and the external magnetic field bias. The studies covered lifetimes of these states, metastability, thermal and quantum mechanical tunneling, and effects of dissipation. At certain bias points of the junction chaotic behavior was found< which was preceded by period-doubling bifurcation. Also negative resistance regions were observed; they can be used for amplification. These observations were supported by computer modeling using a perturbed sine-Gordon equation. Fluxon motion in long Josephson junctions provides an excellent system for studies of nonlinear phenomena and it has a variety of applications to superconducting electronics.

45747 (AD-A–207936/6/XAB) **Vortices in long Josephson junctions. Final report, 15 November 1985-14 November 1988.** Nordman, J.E.; Beyer, J.B. Wisconsin Univ., Madison, WI (USA). Dept. of Electrical and Computer Engineering. 5 Feb 1989. 13p. Available from NTIS, PC A03/MF A01.

This research involved the study of the properties of long Josephson junction structures and the electronic-device possibilities suggested by these structures. A large part of the work involved fabrication and modeling. A particular effort was made to build and to understand the basic operating mechanisms of a type of superconducting transistor, the vortex-flow transistor. The thin-film fabrication techniques were developed using niobium and lead superconductors.

45748 (AD-A–208108/1/XAB) **Heat-transfer and friction factor design data for all-metal compact heat exchangers. Summary report, January 1985-November 1987.** Cain, C.L. Air Force Wright Aeronautical Labs., Wright-Patterson AFB, OH (USA). Mar 1989. 111p. (AFWAL-TR–88-3102). Available from NTIS, PC A06/MF A01.

This report covers analysis and testing Arthur D. Little, Inc conducted under Rotary Reciprocating Refrigerator Development Programs. To improve system life, an effort was undertaken to develop all-metal compact heat exchangers to replace existing heat exchangers that contain organic materials. Eliminating organic materials increases system life because outgassing organics can contaminate the helium working fluid and reduce system life. Perforated plate heat exchangers have been found to have inherently low axial conduction and are therefore excellent candidates for cryogenic applications where an all-metal design is required. A total of 11 plate cores were tested; 2 were chemically etched, 1 was mechanically punched, and 8 were manufactured using electron beam drilling. Hole size, percent open area, and plate thickness parameters were varied among the plates. Experimental results were compared to analytical projections and found to differ significantly. The single-blow transient test technique was used to determine the

heat transfer coefficients and the isothermal pressure drop test was used to determine friction factors, as a function of Reynolds number.

45749 (AERE-G–5004) **Development of remote electrochemical decontamination for hot cell applications. Annual progress report 1988.** Turner, A.D.; Lain, M.J.; Fletcher, P.A.; Dawson, R.K.; Pottinger, J.S. UKAEA Harwell Lab. (UK). Materials Development Div. Jan 1989. 7p. Order Number DE89635273/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The primary aim of the programme is to develop and evaluate remote electrochemical decontamination systems for metal surfaces. The bulk of the waste volume should be reduced to a reuse or low-level waste disposal category, while concentrating most of the activity in a small volume suitable for immobilisation. The goal of the development programme is to test these techniques in both alpha-active and alpha-beta-gamma hot cells in order to ascertain their usefulness as a component of an overall decommissioning strategy. As a result of the radiological environment, particular emphasis will be placed on remote operation in order to reduce occupational radiation exposure. Two types of technique based on the electrochemical dissolution of thin surface layers of the substrate will be investigated: immersion of small items in tanks for electroetching and in situ electropolishing. In both cases, reagents will be chosen with their subsequent disposal in mind. (Author).

45750 (AGA–9015611) **Field techniques to determine electrical shorts between carrier pipe and casing pipe: Final report.** Han, M.K.; Byrne, M.T. Battelle Columbus Div., OH (USA). Dec 1988. 159p. Sponsored by Battelle Columbus Laboratories. (PR–3-703). Available from American Gas Association, 1515 Wilson Blvd., Arlington, VA 22209 $50.00.

This is the final report on Project PR-3-703, "Field Techniques to Determine Electrical Shorts Between Carrier Pipe and Casing Pipe". The objectives of the research have been to develop a reliable field technique, based upon the AC-impedance technique, to determine whether nor not a carrier pipe is electrically (metallically) shorted to a casing pipe, and to develop a prototype instrument for field use. 2 refs., 89 figs., 2 tabs.

45751 (CNBA–8711, pp. 6) **Storage and feeding of biomass.** Bundalli, N. (B.C. Research, Vancouver, B.C., Canada). Canada/New Brunswick Agreement on Conservation and Alternative Energy Activities, Fredericton, NB (Canada). 1987. (CONF-8711323–: Wood-fired boiler workshop, 24-25 Nov 1987; MICROLOG–89-02879). In *Wood-fired boiler workshop.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This paper concerns laboratory research on biomass (wood) hoppers and feeders. Biomass has an enormous resistance to funnelling, but is relatively weak if failure of the material takes place along the walls of the hopper. Desirable shapes of hoppers are discussed. The bin outlets predicted from laboratory evaluations were found to be quite small and had to to confirmed. An 80 m^3 experimental bin was therefore constructed. Screw and belt feeders were tested; these systems can be made to work better with simple modifications that reduce the compaction of the material by the feeder and allow a more uniform flow of material throughout the bin. Along these lines, a new non-consolidating feeder has been developed (patents pending). Further developments are currently underway to allow this feeder to separate large frozen lumps of biomass. 9 figs.

45752 (CONF-890996–5) **A survey of camera error sources in machine vision systems.** Jatko, W.B. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Sensor's expo '89; 12-14 Sep 1989. Order Number DE89014072/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In machine vision applications, such as an automated inspection line, television cameras are commonly used to record scene intensity in a computer memory or frame buffer. Scene data from the image sensor can then be analyzed with a wide variety of feature-detection techniques. Many algorithms found in textbooks on image processing make the implicit simplifying assumption of an ideal input image with clearly defined edges and uniform illumination. The ideal image model is helpful to aid the student in understanding the principles of operation, but when these algorithms are blindly applied to real-world images the results can be unsatisfactory. This paper examines some common measurement errors found in camera sensors and their underlying causes, and possible methods of error compensation. The role of the camera in a typical image-processing system is discussed, with emphasis on the origination of signal distortions. The effects of such things as lighting, optics, and sensor characteristics are considered. 11 refs., 7 figs.

45753 (CONF-8710493–, pp. 97-115) **Modelling and control of refrigerant circuits.** Gruhle, W.D.; Isermann, R. VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA), Duesseldorf (Germany, F.R.). 1987. (In German). From Discussion day on control of space HVAC systems; 15 Oct 1987. In *Control of space HVAC systems. Proceedings.* Order Number DE89915023/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Conventional evaporator control systems involving a thermostatic expansion valve often to not work satisfactorily in terms of stability and evaporator utilization. To improve this, the author first studies the cause of this behaviour by means of theoretic modelling which is greatly determined by processes occurring within the evaporator and by structural combinations. After verification of the simulated model by means of measurements performed on a pilot plant, the results obtained are used to build up a new control system. Various experiments reveal a clearly improved evaporator utilization at greater control stability. (orig.).

45754 (EGG-M–88370) **BR-100 spent fuel shipping cask.** McGuinn, E.J.; Bochard, C.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 7p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570;AC07-88ID12701. (CONF-890631–68: International symposium on packaging and transporting of radioactive materials, 11-16 Jun 1989). Order Number DE89016191/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The BR-100 is a 100-ton rail/barge cask with a capacity of 21 PWR or 52 PWR fuel assemblies that have been cooled for 10 years, either as intact fuel assemblies or consolidated assemblies in canisters. Optional basket designs may permit licensing the cask for a variety of payloads. The following sections describe the philosophy used in establishing the BR-100 cask design and provide a review of results from the life-cycle cost analysis used to prioritize the design parameters. The last section contains a description of the cask design and an outline of the analytical evaluations.

45755 (EGG-M–88372) **The development of an aluminum toroidal shell-type impact limiter.** Mello, R.M.; Wilson, W.K.; Nair, B.R. EG and G Idaho, Inc., Idaho Falls, ID (USA). [1989]. 17p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570;AC07-88ID12699. (CONF-890631–65: International symposium on packaging and transporting of radioactive materials, 11-16 Jun 1989). Order Number DE89016189/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The impact limiters on a Type B transportation cask are designed to absorb the impact energy for the 9-meter (30 foot) drop accident conditions without bottoming out in order to limit deceleration loadings on the cask. Toroidal shell-type impact limiters made from stainless steel have been investigated in the past for transportation cask service in Japan (Y. Sugita and S. Mochizuki) and by the General Electric Company (R.J. Pomares, et al.). These designs were relatively heavy and quite rigid causing high deceleration loads on the cask. This paper presents the results of an investigation to determine the feasibility of an aluminum Alloy 6061-T6 toroidal shell impact limiter for a Legal Weight Truck (LWT) cask being developed by the Westinghouse Corporation for the United States Department of Energy. The incentives for the study were the potential advantages such as a compact configuration, lightweight, durability, and essentially maintenance-free operation. 4 refs., 10 figs.

45756 (EGG-M–88373) **A spent fuel transportation cask for the twenty-first century.** Nair, B.R.; Little, C.C.; Goedicke, F.E. EG and G Idaho, Inc., Idaho Falls, ID (USA); Westinghouse Electric Corp., Pittsburgh, PA (USA). Nuclear Waste Dept. [1989]. 16p.

Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC07-76ID01570;AC07-88ID12699. (CONF-890631–67: International symposium on packaging and transporting of radioactive materials, 11-16 Jun 1989). Order Number DE89016190/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An innovative transportation cask design for legal weight truck shipments of spent nuclear fuel is presented. The proposed approach presents a significant departure from conventional cask designs in that it uses titanium alloy, a material with a high strength-to-weight ratio which has no precedent in transportation cask certification. The significant increase in payload obtainable with the proposed approach, and the associated benefits such as reduced life cycle costs, lower personnel exposure, and lower transportation accident risks are discussed. Also included is the strategy for addressing the challenge of demonstration regulatory compliance for a transportation cask based on new technology. 8 refs., 4 figs., 1 tab.

45757 (EGG-M–89154) **140-B Rail/Barge Spent Fuel Cask development.** Doman, D.R.; Kee, A.T. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 9p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract AC07-76ID01570. (CONF-890631–64: International symposium on packaging and transporting of radioactive materials, 11-16 Jun 1989). Order Number DE89016168/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

The preliminary design of the 140-B Rail/Barge Cask is about 60% complete and incorporates several innovative features which extend current cask design techniques. Discussion of the major items affecting the design and cask features is presented in the following sections. 5 figs.

45758 (IAEA-TECDOC–495, pp. 339-341) **Status of robotics in India.** Ramakumar, M.S. (Bhabha Atomic Research Centre, Bombay (India). Div. of Remote Handling and Robotics). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Robots are often misunderstood to be an attempt to replace human workers in industry. Rather, one can define Robotics as an attempt to create artificially some desirable faculties provided to man by nature. In order that the interests of workers is protected, careful assessment of the use of Robots is needed, especially in countries where availability of technical manpower is copious. The result is orientation of robotics towards use in hazardous, dangerous areas and in applications causing hardship, discomfort to workers. India possesses enormous technical manpower and is anxiously looking forward to implementation of Robots in a way that industry and the workers will benefit. The paper describes the areas in which Robots are likely to be used in the near future in India and the status of Science in the country. (author).

45759 (JINR-N–5(31)-88, pp. 21-25) **Stabilization of spin-polarized atomic hydrogen at low temperature.** Luppov, V.G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy); Pilipenko, Yu.K.; Mertig, M. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012200/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

A cryostat for stabilization of gaseous atomic hydrogen at low temperatures and in high magnetic fields was built up. Gas densities of $\simeq 10^{13}$ atoms/cm^3, which remain stable for more than one hour, were achieved in the first experiments. 6 refs.; 3 figs.

45760 (LA-UR–89-1833) **Spoken commands control robot that handles radioactive materials.** Phelan, P.F.; Keddy, C.; Beugelsdojk. T.J. Los Alamos National Lab., NM (USA). 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8909147–1: American Voice Input/Output Society meeting, Sep 1989). Order Number DE89012632/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Several robotic systems have been developed by Los Alamos National Laboratory to handle radioactive material. Because of safety considerations, the robotic system must be under direct human supervision and interactive control continuously. In this paper, we describe the implementation of a voice-recognition system that permits this control, yet allows the robot to perform complex preprogrammed manipulations without the operator's intervention. To provide better interactive control, we connected to the robot's control computer, a speech synthesis unit, which provides audible feedback to the operator. Thus upon completion of a task or if an emergency arises, an appropriate spoken message can be reported by the control computer. The training programming and operation of this commercially available system are discussed, as are the practical problems encountered during operations.

45761 (N–89-22652) **Analysis of the nonvented fill of a 4.96-cubic-meter lightweight liquid hydrogen tank.** Chato, D.J. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. 1989. 12p. (NASA-TM–102039;E–4750;NAS–1.15:102039;CONF-890819–: ASME/AIChE national heat transfer conference, 6-9 Aug 1989). Available from NTIS, PC A03/MF A01.

As part of its development of cryogenic fluid management techniques for spacecraft, the NASA Lewis Research Center Cryogenic Fluid Technology Office (CFTO) is planning to perform ground tests of nonvented fill techniques on a 4.96-cubic-meter lightweight liquid hydrogen tank. This tank is similar in size and shape to the tankage planned for CFTO's COLD-SAT liquid hydrogen flight experiment. The analyses used to select two injection systems are presented for nonvented fills of this tank at design flow rates between 220 and 450 kg/hr. The first system uses multiple nozzles spraying from the top of the tank through the ullage space. This system should be capable of liquid fill levels in excess of 95 percent. The second system injects the liquid through a submerged nozzle and should produce fill levels on the order of 80 percent liquid.

45762 (N–89-22850) **Performance of all-metal demountable cryogenic seals at superfluid helium temperatures.** Salerno, L.J.; Spivak, A.L.; Kittel, P. National Aeronautics and Space Administration, Moffett Field, CA (USA). Ames Research Center. Apr 1989. 7p. (NASA-TM–102190;A–89101;NAS–1.15:102190;CONF-8906134–: 24. AIAA thermophysics conference, 11-15 Jun 1989). Available from NTIS, PC A02/MF A01.

Two all-metal demountable cryogenic seals with an outside diameter of 36.6 mm, inside diameter of 27.2 mm, and thickness of 0.51 mm were leak-tested at room temperature (300 K), liquid nitrogen temperature (21 cycles at 77 K), liquid helium temperature (9 cycles at 4.2 K), and susperfluid helium temperature (4 cycles at 1.6 K). Each seal was mounted and demounted for 13 cycles. Thickness measurements at 90 deg intervals along the circumference showed a maximum seal compression of 0.038 mm. Leak-rate measurements at all temperatures showed no detectable leak above the helium background level, typically 0.1 x 10(-9) std-cc/sec, during testing.

45763 (N–89-22891) **Rotordynamic Instability Problems in High-Performance Turbomachinery, 1988.** National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Feb 1989. 454p. (NASA-CP–3026;E–4227;NAS–1.55:3026;CONF-8805321–: Workshop on rotordynamic instability problems in high-performance turbomachinery, 16-18 May 1988). Available from NTIS, PC A20/MF A01.

The continuing trend toward a unified view is supported with several developments in the design and manufacture of turbomachines with enhanced stability characteristics along with data and associated numerical/theoretical results. The intent is to provide a continuing impetus for an understanding and resolution of these problems. Topics addressed include: field experience, dampers, seals, impeller forces, bearings, and compressor and rotor modeling.

45764 (N–89-22919) **Effects of lubrication on the performance of high speed spur gears.** Mizutani, Hachiro; Isikawa, Yuuichi; Townsend, D.P. National Aeronautics and Space Administration, Cleveland, OH (USA). Lewis Research Center. Apr 1989. 10p. (NASA-TM–101969;E–4666;NAS–1.15:101969;CONF-8904122–: 5. international power transmission and gearing conference, 25 Apr 1989). Available from NTIS, PC A02/MF A01.

An experimental analysis was conducted to determine power loss and gear noise of high speed spur gears with long addendum under various conditions of load, speed, and oil jet pressure for into mesh lubrication. Power losses were calculated from temperature measurements of lubricating oil, gears, gear box, and oil flow rate. Furthermore, power loss was divided into windage loss, friction loss and churning loss. The results show that windage loss and churning loss were the main components of gear power loss of high gear speed. In addition, lubricating conditions had some influences on gear noise especially under low oil temperature or high viscosity.

45765 (N–89-22940) **Seventeenth NASTRAN (R) Users' Colloquium.** Computer Software Management and Information Center, Athens, CA (USA). Mar 1989. 400p. (NASA-CP–3029;NAS–1.55:3029;CONF-8904258–: 17. NASTRAN users' colloquium, 24-28 Apr 1989). Available from NTIS, PC A17/MF A01; also available from COSMIC, Athens, GA 30602.

General application of finite element methodology and the specific application of the NASA Structural Analysis System, NASTRAN, to a variety of static and dynamic structural problems were reviewed.

45766 (NEI-NO–90, pp. 21) **Navstar/GPS (Global Positioning System). Status and future perspectives.** Fossum, A.; Tegdan, A. Norske Sivilingenioerers Forening, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with the Navstar/GPS (Global Positioning System) which is a part of the navigation- and positioning system used in offshore connections in Norway. The status of today and some future perspectives are discussed. 5 figures.

45767 (NEI-NO–90, pp. 31) **Navstar/GPS (Global Positioning System) by rig positioning. Positioning on Haltenbanken.** Ursin-Holm, B. Norske Sivilingenioerers Forening, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with the positioning of a drilling rig on Haltenbanken on the Norwegian continental shelf. Both the Navstar/GPS (Global Positioning System) and conventional systems were used in the positioning, and the results are discussed and compared. 8 figures.

45768 (NEI-NO–90, pp. 18) **Differential use of Navstar/GPS (Global Positioning System). The DiffStar project.** Hervig, K. Norske Sivilingenioerers Forening, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with the DiffStar project in connection with the differential use of Navstar/GPS (Global Positioning System). The DiffStar system is designed for the control of data from the Navstar/GPS in connection with both the positioning- and pseudo range corrections. 8 figures.

45769 (ORNL/CSD/TM–250) **A preliminary sensitivity analysis of the Generalized Escape System Simulation (GESS) computer program.** Holdeman, J.T.; Liepins, G.E.; Murphy, B.D.; Ohr, S.Y.; Sworski, T.J.; Warner, G.E. Oak Ridge National Lab., TN (USA). Jun 1989. 17p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. Order Number DE89016891/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Generalized Escape System Simulation (GESS) program is a computerized mathematical model for dynamically simulating the performance of existing or developmental aircraft ejection seat systems. The program generates trajectory predictions with 6 degrees of freedom for the aircraft, seat/occupant, occupant alone, and seat alone systems by calculating the forces and torques imposed on these elements by seat catapults, rails, rockets, stabilization and recovery systems included in most escape system configurations. User options are provided to simulate the performance of all conventional escape system designs under most environmental conditions and aircraft attitudes or trajectories. The concept of sensitivity analysis is discussed, as is the usefulness of GESS for retrospective studies, whereby one attempts to determine the aircraft configuration at ejection from the ejection outcome. A very limited and preliminary sensitivity analysis has been done with GESS to study the way the performance of the ejection system changes with certain user-specified options or parameters. A more complete analysis would study correlations, where simultaneous correlated variations of several parameters might affect performance to an extent not predictable from the individual sensitivities. Uncertainty analysis is discussed. Even with this limited analysis, a difficulty with some simulations involving a rolling aircraft has been discovered; the code produces inconsistent trajectories. One explanation is that the integration routine is not able to deal with the stiff differential equations involved. Another possible explanation is that the coding of the coordinate transformations is faulty when large angles are involved. 7 refs., 7 tabs.

45770 (ORNL/TM–11238) **Study and development of advanced control techniques for nuclear reactors and robots.** March-Leuba, C. Oak Ridge National Lab., TN (USA). Aug 1989. 70p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89016937/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Thesis. Submitted to University of Tennessee, Knoxville.

This report studies and develops some aspects of the optimal control theory with the objective of evaluating benefits that the nuclear industry could obtain by applying advanced control techniques. First, the basic relationship between optimal control theory and closed-loop control design has been identified. As a result of this work, new algorithms have been developed for feedback implementations. The applicability of these new algorithms to problems such as state estimation, filtering, model update, and model decoupling has been studied. In addition, new alternatives to control design that are not based on optimal control theory have been developed. A broad range of application examples has been presented for several physical systems, including pressurized water nuclear reactors, boiling water nuclear reactors, steam generators, and robotics. 22 refs., 26 figs.

45771 (SAND–88-3045) **Force reconstruction for the slapdown test of a nuclear transportation cask.** Bateman, V.I.; Carne, T.G.; Gregory, D.L.; Attaway, S.W.; Yoshimura, H.R. Sandia National Labs., Albuquerque, NM (USA). 1989. 29p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890924–1: 12. biennial ASME conference on mechanical vibration and noise, 17-20 Sep 1989). Order Number DE89009571/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Two force reconstruction techniques were used to evaluate the slapdown response of a 1/3 scale model solid steel, spent fuel cask dropped 30 ft onto an unyielding target. The two techniques are: the sum of weighted acceleration technique (SWAT) and the deconvolution technique (DECON). A brief description and the calibration of the techniques as applied to the cask are presented. For the slapdown test, both techniques yielded very similar resultant forces and provided more accurate definition of the force-time history for the cask than is available from conventional data reduction methods. An applied moment, a measurement previously unobtainable from conventional cask accelerometer data reduction techniques, was determined with SWAT. The angular velocity calculated with SWAT was verified with photometric measurements. 9 refs., 22 figs.

45772 (SAND–89-0194C) **A severe human ESD [electrostatic discharge] model for safety and high reliability system qualification testing.** Fisher, R.J. Sandia National Labs., Albuquerque, NM (USA). [1989]. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909176–1: EOS electrostatic discharge symposium, 26-28 Sep 1989). Order Number DE89016177/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A severe human electrostatic discharge (ESD) equivalent source model has been developed for use in qualification testing of systems that have stringent safety or very high reliability requirements. The model produces the now-acknowledged worst-case waveform, and the values of the constituent components have been selected from measured human body electrical parameters to maximize the peak amplitude and rate of rise of the short-circuit discharge current and energy transfer to the victim system. 18 refs., 5 figs.

45773 (SAND–89-0549) **Spent fuel shipping cask sealing concepts.** Sonnier, C.S. Sandia National Labs., Albuquerque, NM (USA). May 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89016922/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In late 1985, the International Atomic Energy Agency (IAEA) requested the US Program for Technical Assistance to IAEA Safeguards (POTAS) to provide a study which examined sealing concepts for application to spent fuel shipping casks. This request was approved, and assigned to Sandia National Laboratories (Sandia). In the course of this study, discussions were held with personnel in the International Safeguards Community who were familiar with the shipping casks used in their States. A number of shipping casks were examined, and discussions were held with two shipping cask manufacturers in the US. As a result of these efforts, it was concluded that the shipping casks provided an extremely good containment, and that many of the existing casks can be effectively sealed by applying the seal to the cask closure bolts/nuts.

45774 (SAND–89-0781C) **Gas-accelerated plate stability study.** Barker, L.M.; Chhabildas, L.C. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–18: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016880/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Flier plates are launched to hypervelocities using gas pressures in the megabar range. Flash x-rays which record the integrity of the launched plates show that they normally disintegrate. Experiments to enhance the flier plate stability have included variations in plate material, the use of buffer materials, and various schemes for mitigating violent edge effects. The smoothness of the drive is also discussed, and the study which led to the launching of an intact plate to 5.7 km/s is described. 4 refs., 3 figs.

45775 (SAND–89-0788C) **The role of sensor directed, model based control in robotics.** Harrigan, R.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909167–1: IROS '89: international workshop on intelligent robots and systems: the autonomous robot and its application, 4-6 Sep 1989). Order Number DE89014133/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper discusses the use of model based control of industrial robots to achieve automatic programming of robot trajectories, hybrid force/position control and computer assisted manual operation. Experiments at Sandia National Laboratories are reviewed to illustrate the impact of model based control on the operation of robotic systems. Computer models of the robots and their operating environments are complemented with environmental sensing. Sensing allows correlation of modeled geometries with the location of objects in the actual environment. In addition, sensors detect error situations which may require operator attention prior to continued system operation. Computer models are used to verify the validity of sensor data before the robotic system executes operations based upon those data. 12 refs., 7 figs.

45776 (SAND–89-0833) **A PFV_2 accelerometer for high shock applications.** Tise, B.; Smith, T. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 86p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89015167/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report describes the development, fabrication, and testing of a high-g piezoelectric accelerometer that uses PVF_2 as the piezoelectric transducer. The accelerometer is designed to continuously measure accelerations up to 1000,000 g. The device is packages in a 3/8" hex head bolt and can include a built-in hybrid buffer to provide a low-output impedance analog signal. Included in this report are fabrication procedures, mechanical drawings, and software listings for test data analysis programs. 30 refs., 21 figs.

45777 (SAND–89-0919C) **Stand-off shields for hypervelocity particles.** Lawrence, R.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–8: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016182/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Stand-off hypervelocity particle shields offer potential weight savings of an order of magnitude or more over conventional homogeneous armors. Based on an earlier complete model for the design and optimization of a stand-of shield system, a more restricted model appropriate for retrofit shields is described. Procedures to minimize the shield mass are provided, and scaling laws for many of the important parameter relationships are illustrated. 6 refs., 5 figs.

45778 (SAND–89-1881C) **VIBRAFUGE: A combined environment testing facility — vibration testing on a centrifuge.** Doggett, J.; Cericola, F. Sandia National Labs., Albuquerque, NM (USA). 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909168–1: Society of Automotive Engineers (SAE) aerotech '89, 25-28 Sep 1989). Order Number DE89015120/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Vibration testing in a centrifuge acceleration field (up to 50 gs) can be accomplished in either of two axes relative to the centrifuge acceleration with a modified, commercially available, electrodynamic shaker and the use of a specially designed orthogonal motion converter. Fixing the shaker armature axis in-line with the centrifuge arm (head towards the pivot) keeps the inertial forces on the head in the one direction which can be offset with servo controlled pneumatic bags located beneath the shaker head. Testing in an axis perpendicular to the principal axis is accomplished with the orthogonal motion converter which is driven by the shaker head. 13 figs.

45779 (SFB–151-12) **SSI 2D/3D soil structure interaction: A program system for the calculation of structure-soil interactions using the boundary element method. Project C1. Vibrational behaviour of structural components, taking into account soil-structure interactions.** Schmid, G.; Willms, G.; Huh, Y.; Gibhardt, M. Bochum Univ. (Germany, F.R.). Sonderforschungsbereich 151 - Tragverhalten und Tragfaehigkeit von Baukonstruktionen unter Dynamischen Einwirkungen. Dec 1988. 186p. (In German). Available from Copy held by UB/TIB Hannover.

SSI 2D/3D is a computer programm to calculate dynamic stiffness matrices for soil-structure-interaction problems in frequency domain. It is applicable to two- or three-dimensional situations. The present report is a detailed manual for the use of the computer code written in FORTRAN 77. In addition it gives a survey of the possibilities of the Boundary Element Method applied to dynamic problems in infinite domains. (orig.).

45780 (UCRL–100718) **Low-cost three-dimensional stereoscopic display technique for computer-aided design.** Luft, P.A.; Bradley, G. Lawrence Livermore National Lab., CA (USA). 1 May 1989. 10p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-7405-ENG-48. (CONF-8909111–1: Computer graphics world computervision international user conference, 10-13 Sep 1989). Order Number DE89011635/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper describes a procedure for obtaining low-cost stereoscopic imagery on any computer-aided design system that has color capability and models its data in 3-D form. This technique works independently of installed hardware or software. Stereoscopic imagery is valuable in the design process because it simplifies and clarifies complex computer-modeled parts and assemblies. Thus, the design and manufacturing processes benefit from better communication and fewer errors. 2 refs., 4 figs.

45781 (UCRL–101190) **Validation of NEC [Numerical Electromagnetics Code] for antennas near ground.** Burke, G.J.

Lawrence Livermore National Lab., CA (USA). Jun 1989. 12p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-890660–9: Institute of Electrical and Electronics Engineers (IEEE) Antennas Propagation Society (AP-S) international symposium, 26-30 Jun 1989). Order Number DE89016502/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Around 1980, a project was begun at LLNL to develop an accurate model for antennas above or buried in the ground in the general-purpose antenna code NEC. This effort started with a moderately complex formulation in which the field of a point source near ground was included in the kernel of the electric field integral equation. To maintain reasonable computation times, algorithms involving table lookup and least-squares approximation were developed to supply the many field values needed in the moment method solution. The complexity and tradeoffs in this approach and the goal of modeling arbitrary wire antennas led to a need for extensive validation and testing of the code. Since little good experimental data or known ground parameters was available, much of the validation of the model has relied on internal self-consistency checks and comparisons with independent analytical or numerical results. The balance of input and radiated power, boundary values of the fields and reasonable behavior of the solution in convergence and other limits have provided valuable information. Initially, simple antennas such as a horizontal dipole or vertical wire penetrating the ground were modeled, followed by more complex cases such as a monopole on a radial wire ground screen. The code has since received an extensive "wringing out" in the hands of DoD users and contractors. Reasonable confidence in the code has been built up for many types of antennas and some problems have been uncovered. The history of debugging and validation of the NEC ground model is summarized here. Although validation was not a separate task in this project, the steps were probably similar to what occurs with many other large codes. 18 refs., 6 figs.

45782 **Method of creating a large magnetic field in a hollow cylindrical superconducting ring.** Leupold, H.A. To Department of the Army, Washington, DC. USA Patent 7-335,632. 10 Apr 1989. 8p. Available from NTIS, PC A02/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

A large magnetic field is created in a hollow cylindrical superconducting ring by a method including the steps of: (A) placing a snugly fitting cylinder of iron within the ring, (B) magnetizing the iron along its axis by means of a small applied field to its saturation induction, at a temperature above the transition temperature of superconducting ring material, (C) cooling the iron contained in the hollow cylindrical superconducting ring to below the transition temperature of the superconducting ring material, and (D) removing the applied field and the iron cylinder.

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Refer also to citation(s) 45581, 45725, 46538, 46635, 46668, 46734, 46784

45783 (AD-A–207838/4/XAB) **SDIO/IST ultrashort-wavelength laser: Novel experimental schemes for observing the Moessbauer effect in long-lived nuclear levels and nuclear coherent states. Rept. No. 2, for 27 May 1988-27 February 1989.** Hoy, G.R. Old Dominion Univ., Norfolk, VA (USA). Dept. of Physics. Mar 1989. 21p. Available from NTIS, PC A03/MF A01.

There are several aspects of the single-crystal, self-absorption, source technique that have needed further analysis. This report explains the calculational study designed to improve the theoretical model by incorporating a gaussian, source distribution and including solid-angle effects. These experiments were done in the vertical geometry. i.e., the single crystal is lying flat and the Ge detector is positioned below. In this configuration there are two solid-angle effects: not only the fact that different sample slices subtend slightly different solid-angles at the detector, but also the fact that, due to the contraction of the dewar-sample system itself, an overall temperature dependent solid-angle effect is produced.

45784 (BNL–42393) **A compact x-ray free electron laser.** Barletta, W.; Attac, M.; Cline, D.B.; Kolonko, J.; Wang, X.; Bhowmik, A.; Bobbs, B.; Cover, R.A.; Dixon, F.P.; Rakowsky, G.; Gallardo, J.; Pellegrini, C.; Westenskow, G. Brookhaven National Lab., Upton, NY (USA). 9 Sep 1988. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016;W-7405-ENG-48. (CONF-880904–11: 4. topical meeting on short wavelength coherent radiation: generation and applications, 26-29 Sep 1988). Order Number DE89017236/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We present a design concept and simulation of the performance of a compact x-ray, free electron laser driven by ultra-high gradient rf-linacs. The accelerator design is based on recent advances in high gradient technology by a LLNL/SLAC/LBL collaboration and on the development of bright, high current electron sources by BNL and LANL. The GeV electron beams generated with such accelerators can be concerted to soft x-rays in the range from 2–10 nm by passage through short period, high fields strength wigglers as are being designed at Rocketdyne. Linear light sources of this type can produce trains of picosecond (or shorter) pulses of extremely high spectral brilliance suitable for flash holography of biological specimens in vivo and for studies of fast chemical reactions. 12 refs., 8 figs., 4 tabs.

45785 **Progress towards a 44-Å x-ray laser.** MacGowan, B.J. (Univ. of California, Berkeley (USA)); Bourgade, J.L.; Combis, P.; Keane, C.J.; London, R.A.; Louis-Jacquet, M.; Matthews, D.L.; Maxon, S.; Naccache, D.; Rosen, M.D.; Thiell, G.; Whelan, D.A. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract AC03-76SF00098. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Since 1984 when soft x-ray amplification was convincingly demonstrated at XUV wavelengths near 200 Å, much effort has gone into obtaining soft x-ray gain at shorter wavelengths. One motivation is the possibility of using a high brightness source of amplified spontaneous emission to perform holography of live biological specimens over short time scales. 33 refs., 4 figs., 3 tabs.

45786 **Observation of extreme ultraviolet amplification in 3-2 (42~46Å), 4-3 (130.5Å) and 5-4 (305Å) transitions in laser produced He-like Al plasma.** Kuroda, H. (Univ. of Tokyo (Japan)); Muroo, K.; Naito, K.; Tanaka, Y. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

To demonstrate the XUV stimulated emission process in plasma produced by 100 ps glass-laser pulse, close to the water window region, XUV and x-ray spectroscopic measurements are done by adopting He-like Al 3-2, 4-3, or 5-4 transition scheme. This scheme is simple and predictable by the spectroscopic analysis, and suitable to demonstrate the induced emission of the shorter wavelength than any other transition ever attained.

45787 **12.8 eV laser in neutral cesium.** Barty, C.P.J. (Stanford Univ., CA (USA)); King, D.A.; Yin, G.Y.; Hahn, K.H.; Field, J.E.; Young, J.F.; Harris, S.E. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors report the operation of a saturated 12.8 cV (96.9 nm) laser in Cs vapor that has an extrapolated small signal gain of exp(83) in a total length of 17 cm. They believe that lasing occurs from a core-excited level embedded in the continuum of the valence electron. The laser is pumped by soft x-rays from a synchronous, traveling-wave, laser-produced plasma. 21 refs., 8 figs.

45788 **X-ray laser experiment with double pass device and long-recombing-plasma column.** Jaegle, P. (Universite Paris-Sud, Orsay (France)); Carillon, A.; Dhez, P.; Gauthe, B.; Gadi, F.; Jamelon, G.; Klisnick, A. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The results reported here, are time integrated measurements of soft x-ray amplification obtained with the new experimental set-up involving a single normal incidence multilayered mirror, put at the rear of a 60mm laser-plasma column. After a brief description of the experimental system, the authors report the first results obtained at 10.57nm by comparing intensities of single-pass ASE and of double-pass with the mirror. The target is a thin aluminum layer with a thickness optimizing the population inversion on lithium-like Al^{+10} ions. The pumping is produced by recombination mechanisms during the plasma cooling. From the single to the double pass X-ray beam, the lines exhibit significant differences, both in peak intensities and widths. First, double-passing enhances the 10.57nm line intensity much more than mirror reflection would do without any amplification by the plasma. Secondly, and concomitantly, one observes a line width decreasing of about 30%. This is supposed due to a core size decreasing of the zone emitting the line. To explain how the cross-section of the double pass beam can be reduced during propagation trough the plasma column we suggest to consider the focussing effects due to the gain coefficient profile. 13 refs., 4 figs.

45789 Short wavelength lasers: Something new, something old. Hagelstein, P.L. (Massachusetts Institute of Technology, Cambridge (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Significant amplification in the EUV and soft x-ray spectral regimes have been demonstrated recently at a number of laboratories using very high power ICF class lasers as pump sources. The author discusses in this paper the possibility of developing short wavelength lasers on a smaller scale by scaling the electron collisional scheme in nickel-like ions to lower Z. Additionally, he examines population inversions in neodynium-like ions as an alternate route towards a small scale soft x-ray laser. He considers specifically the design of a transient nickel-like molybdenum collisional laser based on a 4d-4p trransition near 194 Å. Such a laser could be driven by a 10 Joule Nd:glass pump laser system. In addition he considers the extension of the electron collisional scheme to neodynium-like U, in which the monopole-excited 5f-5d transition occurs near 71 Å. 13 refs., 15 figs.

45790 X-ray laser related experiments and theory at Princeton. Suckewer, S. (Princeton Univ., NJ (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

This paper describes a new system for the development of an X-ray laser in the wavelength region from 5 nm to 1 nm utilizing a Powerful Sub-Picosecond Laser (PP-Laser) of expected peak power up to 0.5 TW in a 300 fsec pulse. Soft X-ray spectra generated by the interaction of the PP-Laser beam with different targets are presented and compared to the spectra generated by a much less intense laser beam (20-30 GW). A theoretical model for the interaction of atoms with such a strong laser EM field is also briefly discussed. The development of additional amplifiers for the recombining soft X-ray laser and the design of a cavity are presented from the point of view of applications for X-ray microscopy and microlithography. The overview ends with the presentation of recent results on the quenching of spontaneous emission radiation and its possible effect on the absolute intensity calibration of soft X-ray spectrometers. 26 refs., 18 figs.

45791 Amplification in Ne XI Hα, Mg XII Hα and Al XIII Hα transitions. Kato, Y. (Osaka Univ. (Japan)); Yamanaka, M.; Daido, H.; Tachi, T.; Nishimura, H.; Shiraga, H.; Miura, E.; Herman, P.R.; Takabe, H.; Jitsuno, T.; Takagi, M.; Nakai, S.; Yamanaka, C.; Key, M.H.; Tallents, G.J.; Rose, S.J. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Observation of gain in Balmer-α (H α) transitions in Na XI, Mg XII and Al XIII is reported. Planer stripe targets were irradiated with intense, line-focused 351 nm laser light. Time evolution of the gain in Na XI Hα is also presented. 11 refs., 5 figs.

45792 Population inversion through charge exchange process in plasmas. Kato, T. (Nagoya Univ. (Japan)); Masai, K.; Fujimoto, T. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Population inversion due to charge exchange processes is investigated for helium-like ions in tokamaks by using a collisional radiative model. Dependence of charge exchange cross sections on the quantum numbers n, l is estimated from the observed spectra. 8 refs., 7 figs., 2 tabs.

45793 Prepulsing to increase the efficiency of laser-produced plasma pumped lasers. Sher, M.H. (Stanford Univ., CA (USA)); Benerofe, S.J. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors have demonstrated the use of a low energy prepulse to enhance the soft-x-ray emission of laser produced plasmas in a parameter range which has been used to pump photoionization lasers. They present data on conversion efficiency and output pulse duration as a function of input intensity, pulselength, and prepulse conditions. Their goal in these studies is to allow the design of more efficient short-wavelength photoionization lasers, and to achieve high repetition rate operation of these lasers in the near future. 13 refs., 10 figs.

45794 Amplification and gain measurement of extreme ultraviolet radiation (42.4Å, 45Å and 46Å) in He-like Al laser plasma. Muroo, K. (Univ. of Tokyo (Japan)); Tanaka, Y.; Kuroda, H. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Concerning the extreme ultraviolet lasing in the laser-produced plasma, He-like Al scheme is attractive because the wavelength of He-like 3-2 transitions are shorter than any other transition ever done, and very close to the water window. This scheme is expected to give a large population inversion caused by the rapid decaying of the n=2 level, and the great feed to the n=3 levels by the cascade radiative transitions and two electron transitions through the autoionized states.

45795 Population inversions between n=5, 4, 3 and 2 levels of He-like Al plasma observed by spatially resolved X-ray spectroscopy. Kuroda, H. (Univ. of Tokyo (Japan)); Katsuragawa, M.; Muroo, K.; Tanaka, Y. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Population inversions between N=5, 4 and 3 levels are observed in a 100ps laser-produced plasma. As a result, XUV of 42Å~46Å, 130Å and 305Å corresponding to 3-2, 4-3 and 5-4 transitions are observed experimentally. Relative population densities are determined by measuring the intensities of spatially resolved X-ray line spectra of 6.635Å, 6.314Å and 6.18Å corresponding to the 3-1, 4-1 and 5-1 transitions, which are normalized by their oscillation strengths. Careful absorption was paid to rule out the effect of reabsorption. Populations were inverted at the region located 50~100μm from the target surface. Laser light was focused into 50μm diameter and amount of inversion was clearly increased when laser intensities was increased. As to the 5-4 and 4-3 inversion, similar result was observed in silicon target, however inversion between n=3 and 2 was not confirmed at these laser intensities. XUV gains are very promising especially as to 5-4 and 4-3 transitions in both target.

45796 Probability of soft x-ray radiation for 3p-3s transition in neon-like iron. Peng, Huimin (Institute of Applied Physics and Computational Mathematics, Beijing (China)); Zhang, Guoping; Sheng, Jiatian; Shao, Yunfeng. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Using 1-D non-LTE-radiative hydrodynamic code JB-19 the authors simulated the interactions of basic and double frequency neodymium-glass laser beam which is focussed into a line onto target, with thin Formvar-iron foils. The values of population inversions and gains are calculated using steady rate equations. The profiles of laser-produced plasma conditions and the probabilities for 30-3s transition in neon-like iron at peak intensities 5TW per square centimeter to 20TW per square centimeter and FWHM 800-1,000ps are shown. 8 refs., 9 figs., 2 tabs.

45797 Harmonic generation in laser-free electron scattering reconsidered. Puntajer, A.K. (Univ. of Innsbruck (Austria)); Leubner, C. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

For zero electron drift velocity, the corrected version of Vachaspati's classical cross sections deviates strongly from a semi-classical one by Ehlotzky and from an unpublished quantum electrodynamical cross section by Jafarpour. Therefore, the cross section is recalculated within classical electrodynamics, which suffices for the experimental configurations in question. This classical cross section, derivable more simply and with fewer approximations than the semi-classical one, nevertheless agrees perfectly with Elotzky's result for all harmonics, but only to some extend with Vachaspati's earlier version of the classical second harmonic cross section, and not at all with his corrected one, nor with Jafarpour's quantum electrodynamical one. Moreover, it also incorporates relativistic Thomson scattering as envisaged by McDonald. For second harmonic scattering, there is perfect agreement between the semi-classical cross section and the present classical one. Vachaspati's earlier version agrees to some extend, whereas his corrected one and Jafarpour's unpublished QED cross section deviate strongly. Even for zero electron drift velocity, the cross section exhibits a marked forward-backward asymmetry, briefly mentioned by Sarachik and Schappert. It can be explained as an interference between the fields produced by the linear and nonlinear components of the electron motion, and it renders Englert and Rinehart's direction of observation most unfavorable for observing second harmonic photons. 7 refs., 1 fig.

45798 Gain guided x-ray beams. Fill, E.E. (Max-Planck-Institut fur Quantenoptik, Garching (Germany F.R.)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

It is shown that with gain and index profiles of typical x-ray laser experiments the x-ray beam is guided by the gain profile rather than defocussed by the refractive index distribution. An arbitrary beam generated within the medium or injected into the medium is quickly transformed into a 'matching' beam, propagating without change. The effective gain of the matching beam is somewhat lower than the gain at the maximum of the gain distribution. If the gain distribution exhibits a small curvature in direction of beam propagation the effective gain is dramatically reduced. 7 refs., 4 figs.

45799 CO_2 laser-heated plasmas for electron-collisionally pumped XUV laser studies. Enright, G.D. (National Research Council of Canada, Ottawa, Ontario); Burnett, N.H. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors describe a series of experiments to characterize plasmas produced by moderate intensity ($\approx 2x10^{13}$ W/cm^2), nanosecond pulse, CO_2 laser irradiation of planar targets using both line (150 μM x 7 mm) and spherical (1 mm diam.) focussing optics. X-ray line and continuum diagnostics have been used to infer a heat front penetration of about 20 μgm/cm^2 at temperatures of approximately 300 eV. They observe only minor differences between targets whose mass is small compared to the hot electron range and much more massive ones, indicating a poor efficiency for hot electron reflexing in thin targets. In the case of Cu targets, observations of L shell x-ray transitions from neon and fluorine-like ions show a similar ionization distribution of 1 μm laser produced plasmas in which gain has recently been demonstrated. The Ne-like Cu XX 3p-3s emission lines have been observed. A comparison of on-axis to off-axis spectra provides evidence for gain on these lines. 14 refs., 10 figs., 1 tab.

45800 Ne-like ion x-ray laser experiments in plasmas produced by 0.53-μm and 0.35-μm laser light. Keane, C.J. (Livermore Livermore National Lab., CA (USA)); Bourgade, J.L.; Combis, P.; London, R.A.; Louis-Jacquet, M.; MacGowan, B.J.; Matthews, D.L.; Naccache, D.; Peyrusse, O.; Rosen, M.D.; Thiell, G.; Whitten, B. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Recent Ne-like ion x-ray laser experiments carried out at the Centre d'Etudes de Limeil-Valenton (CEL-V) with both 0.53-μm and 0.35-μm laser light will be described. This paper will concentrate primarily on the observation of amplification in Ne-like Sr (Z=38) in plasmas produced by 0.53-μm laser light. Small signal gains of 4.4 cm^{-1} and 4.0 cm^{-1} have been measured for the Ne-like Sr J=2-1 transitions at 164.1 and 166.5 Å, respectively. In addition, the effects of pumping the Ne-like Se laser with 0.35-μm light have been investigated. The resulting Se spectra do not differ significantly from those observed with 0.53-μm light. A brief summary of other experiments carried out at CEL-V will also be given. 18 refs., 5 figs., 1 tab.

45801 Capillary discharge plasmas as extreme ultraviolet laser sources. Rocca, J.J. (Colorado State Univ., Fort Collins (USA)); Marconi, M.C.; Muniz, M.V.; Beethe, D.C. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors propose the generation of XUV and soft x-ray laser radiation by electron-ion recombination in capillary plasmas excited by fast discharges. Highly ionized plasmas are created in a capillary geometry by a high current pulse; subsequently rapid cooling of the plasma occurs by electron heat conduction and radiation. Electron-ion recombination is expected to result in population inversion and gain in 3-2 transitions of hydrogenic ions with wavelengths ranging from the VUV to soft x-rays. They have generated nearly completely ionized helium and lithium capillary plasmas to study the possibility of amplification in the 3-2 hydrogenic lines during plasma recombination. Time resolved XUV spectra of a 500 μm diameter lithium capillary discharge were obtained. The intensity of the LiIII 72.9 nm 3-2 line is observed to increase during the decay of the current pulse. The capillary discharge recombination scheme is expected to advantageously scale to soft x-rays wavelengths. A time dependent collisional-radiative model of the capillary plasmas predicts a gain of 5 cm^{-1} in the 18.2 nm CVI transition. 10 refs., 8 fig.

45802 Continuous anti-Stokes Raman laser operation. Feitisch, A. (Universitaet Hannover (Germany, F.R.)); Wellegehausen, B. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The non parametric anti-Stokes Raman process provides a possibility for the efficient upconversion of infrared or visible laser radiation into the UV and VUV spectral range. Especially for cw operation the active materials in discharge excited gas laser systems may be used. A first cw system has been operated in an argon ion

laser, where 648.3 nm radiation of a dye laser could be converted into 437.5 nm radiation, with a conversion efficiency of more than 20 % and a maximum output power of 150 mW. 6 refs., 2 figs.

45803 High power, short pulse ultra-violet laser for the development of a new x-ray laser. Meixler, L.D. (Princeton Univ., NJ (USA)); Nam, C.H.; Robinson, J.; Tighe, W.; Krushelnick, K.; Suckewer, S.; Goldhar, J.; Seely, J.; Feldman, U. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A high power, short pulse ultra-violet laser system (Powerful Picosecond-Laser) has been developed at Princeton Plasma Physics Laboratory (PPPL) as part of experiments designed to generate shorter wavelength x-ray lasers. With the addition of pulse compression and a final KrF amplifier the laser output is expected to have reached 1/3-1/2 TW levels. The laser system, particularly the final amplifier, will be described along with some initial soft x-ray spectra from laser-target experiments. The front-end of the PP-Laser provides an output of 20-30 GW and can be focussed to intensities of $\sim 10^{16}$ W/cm^2. Experiments using this output to examine the effects of a prepulse on laser-target interaction will be described. 19 refs., 14 figs.

45804 Soft x-ray amplification in a magnetically confined recombining H-like and Li-like plasma. Kim, D. (Princeton Univ., NJ (USA)); Skinner, C.H.; Wouters, A.; Valeo, E.; Voorhees, D.; Suckewer, S. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A series of experiments with H-like carbon has been performed using a Nd/Glass laser (maximum output energy is 100 J in 3 nsecs) in a line focus configuration. The maximum gain observed was 8.1 cm^{-1} using 25 J laser energy. This work is an initial step toward the development of a soft x-ray amplifier for the presently operating C VI 182 Å soft x-ray laser in a CO_2 laser produced plasma confined in a magnetic field. The possibility of lasing action at 187.2 Å in Li-like Mg X, 154.7 Å in Li-like Al XI, and 129 Å in Li-like Si XII in a magnetically confined recombing plasma has been also investigated. A CO_2 laser was focused onto a target assembly and the resulting plasma confined in a solenoidal magnet field up to 9 Tesla. Impurities such as iron or titanium were introduced to increase the cooling in the recombination phase to produce more favorable conditions for high gain. Gain-length products of $1 \sim 2$ at 187.2 Å in Mg X, $3 \sim 4$ at 154.7 Å in Al XI, and $1 \sim 2$ at 129 Å in Si XII were observed. To better understand plasma dynamics, a one-dimensional hydro-atomic code has been developed to simulate the experiment. The comparison between experiments and computer simulation will be discussed. 13 refs., 11 figs.

45805 Calculation and design of Ni-like W soft x-ray lasers. Maxon, S. (Lawrence Livermore National Lab., CA (USA)); Dalhed, S.; Hagelstein, P.; MacGowan, B.; London, R.; Rosen, M. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Gain on 0-1 transitions has now been demonstrated in Ni-like Eu and Yb using targets between 60 and 100 μg/cm^2. The intensities of the input laser were 7×10^{13} W/cm^2 (Eu) and 1.4×10^{14} W/cm^2 (Yb). The measured gain coefficient on the 71Å (Eu) and the 50.3Å line (Yb) was 1 cm^{-1}. Using a modified version of the Lagrangian hydrodynamics code LASNEX together with the kinetics code XRASER, the calculated gains are in reasonable agreement with experiment. In Ni-like W, the leading 0-1 transition has the wavelength 43.11Å. 1D calculations for 90 μg/cm^2 targets irradiated by a 3w Gaussian pulse show an increase in the gain coefficient from 1 to 2.6 cm^{-1} as the intensity is increased from 2.2×10^{14} to 2.6×10^{14} W/cm^2. The electron temperature, at the peak of the input pulse, increases from 0.8 to 0.95 keV. A more dramatic effect is seen by using square pulses (3w). The gain coefficient increases from 2 to 6 cm^{-1} when the intensity is increased from 1.8×10^{14} to 2.2×10^{14} W/cm^2. The electron density for the square pulse is a factor 2.5-3.0 times larger than the Gaussian pulse. The modified version of LASNEX which was used to run these problems radiates more energy producing lower temperatures in the plasma. 3 refs.

45806 Quantum-mechanical interference in four-wave mixing. Chapple, P.B. (Australian National Univ., Canberra); Baldwin, K.G.H.; Bachor, H.A. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Interference between two different quantum-mechanical pathways for 4 wave mixing in sodium vapor has been observed. The 4 wave mixing was enhanced by 2-photon resonance with the 5s state, for one pathway, and the 4d state, for the other. The phase of the interference could be varied continuously by varying laser frequencies, and constructive and destructive interference effects were studied. A model based on third-order perturbation theory gives a good description of the features observed. 12 refs., 3 figs.

45807 Transversely optically pumped ultraviolet laser in the range of 330-390 nm. Yu, Junhua (Harbin Institute of Technology (China)); Sun, Shangwen; Cheng, Yongkang; Tang, Chen; Ma, Zuguang. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A series of six laser lines at 330-390 nm on the $B^3\,\Sigma^-_u \rightarrow X^3\,\Sigma^-_g$ transition in sulfur dimer vapor transversely-pumped by a XeCl laser at 308.1 nm was first observed and the corresponding absorption coefficient and the small signal gain coefficient were measured. The mean gain is about 0.30 cm^{-1}. Sulfur dimer laser due to its high efficient, low pumping threshold and broad distributed spectrum was attractive as a blue-green laser for ocean-optics but it is also a promising candidate for an efficient ultraviolet laser system. The shortest wavelength of UV lasing on the B→X transition in S_2 at 365 nm was achieved by S.R. Leone and K.G. Kosnik. The authors realized the anticipated extending of the S_2 UV lasing region towards the shorter wavelength for about 35 nm, while a XeCl excimer laser transversely pumped the T-shaped quartz cell with a plane-plane cavity. 7 refs., 5 figs., 1 tab.

45808 Spectra of lead, bismuth, thorium and uranium relevent to a neodymium-like soft x-ray lasing scheme. Hodge, W.L. (High Energy Laser Associates, Oakland, CA (USA)); Filbert, P.C.; Kohler, D.A.; Navoda, C.L.; Perez, J.D.; Hagelstein, P.L.; Maxon, S.; Scofield, J.H.; Peek, J.M. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The Nd-like isoelectronic sequence (60 electrons) of high Z elements could provide the basis for a soft x-ray laser(1). Gain may be possible at approximately 70 A for the 5f-5d transition in Nd-like Uranium. The potential advantage is that a medium power Nd:glass laser (10E12 to 10E13 watts/cm2) is sufficient to create a soft x-ray laser. As a first step in this development, soft x-ray spectra from Pb, Bi, Th and U were taken. These results will be presented along with three different atomic structure computer calculations of transition energies. The spectra were produced with 10E11 to 10E14 watt/cm2 of laser power from the Lockheed Pulsed Laser Facility. Time integrated and theoretical spectra of Uranium are displayed in figure 1. The data is dominated by broad unresolved transition arrays (UTAs) from 5-5 and 6-5 transitions. The theoretical spectrum was created using calculated gf values and wavelengths for the Nd-, Pm- and Sm-like isoelectronic sequences. This comparison partially explains the gross features of the experimental data. Transitions from a large number of other ionization states will help form the broad UTAs. 1 ref., 1 fig.

45809 Soft x-ray lasing of Li-like ions in laser-produced plasmas. Lee, Y.T. (Lawrence Livermore National Lab., CA (USA)); Howard, W.M. pp. 436 of Short wavelength coherent radiation:

Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Several demonstrations of lasing in the extreme-ultraviolet (XUV) wavelength region have been successfully achieved using either collision or recombination pumping. The first successful demonstration was reported for the 3p-3s transitions in Ne-like selenium ions. Laser transitions at shorter wavelengths have also been achieved by using the 4d-4p transitions in Ni-like ions. These schemes are based on collisional excitation pumping, while in other successful schemes the upper lasing levels are populated directly by recombination processes. However, lasing using resonant photo-pumping in the XUV wavelength region has not yet been demonstrated. In resonant photo-pumping, the emission from one ion is used to pump a transition in the ion of a different element. A successful resonance scheme requires a close overlap between the wavelengths of these transitions. This concept for achieving population inversions of ions in plasmas was first proposed by Vinogradove et al. and by Norton and Peacock. Although several schemes for achieving laser amplification in the sub 100 Å wavelength region have been proposed, the shortest wavelength at which significant gain has been measured by using photo-pumping is 2163 Å. Recently, the authors propose a new laser scheme based on resonant photo-pumping of Li-like ions using Kα radiation. In particular, they consider the lasing plasma to be a thin iron foil and the pump radiation source to be an aluminum slab. Both of these targets are assumed to be irradiated by a high-power optical laser. The radiation from the $2p_{3/2}$-$1s_{1/2}$ transition of H-like aluminum ions in the source is used to pump the $5p_{1/2}$ and $5p_{3/2}$ levels of Li-like iron ions in the lasing plasma. Pumping of the 5p levels results in gains for the transitions between the n=5 and n=4 levels at the wavelengths of 70 Å.

45810 Time development of amplification in Na XI Hα-line at 54.19 Å. Nishimura, H. (Osaka Univ. (Japan)); Shiraga, H.; Daido, H.; Tachi, T.; Herman, P.R.; Miura, E.; Takabe, H.; Yamanaka, M.; Kato, Y.; Tallents, G.J.; Key, M.H. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Temporal behavior of the Na XI Balmer-α (Hα) transition in a laser-produced NaF plasma is experimentally investigated. The time variation of the gain value was derived from the ratio of the Hα intensities along and transverse to the x-ray laser axis. The Na XI Hα line is amplified during 100-500 psec after laser irradiation with the maximum gain of 2-4 cm^{-1}. The experimental result is in close agreement with a model calculation using a 2-dimensional hydrodynamic code. 8 refs., 7 figs.

45811 Gain measurement on a 18.2-nm carbon recombination laser produced by an intense CO_2 laser. Daido, H. (Osaka Univ. (Japan)); Miura, E.; Kitagawa, Y.; Nishihara, K.; Kato, Y.; Yamanaka, C.; Nakai, S. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors propose a cylinder-type target as a carbon recombination laser medium made of 30-μm thick parylene (C_8H_8) whose diameter and length are 3MM and 3mm-12mm, respectively. The high power CO_2 laser (500J in 50ns) irradiates a 2,500-Å thick parylene foil attached to the end of the cylinder. Then the plasma from the thin foil and the cylinder wall produced by the scattered light expands and is confined in the cylinder, producing an almost uniform plasma without magnetic field. The plasma length of more than 1 cm was observed with x-ray pinhole camera. They measured the gain of CVI 3d-2p line (18.2 nm) using the axial and the transverse spectrometers. The maximum gain length product of 2.4 at cylinder length of the 12 mm was obtained. 19 refs., 5 figs.

45812 Narrow line x-ray transition radiation by electron beam traversing a solid-state superlattice. Kaplan, A.E. (Johns Hopkins Univ., Baltimore, MD (USA)); Law, C.T. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Soft x-ray can be generated by low energy electron beams traversing a periodic layered medium with very short spatial period as was shown previously by Kaplan and Datta. The authors show that a combination of materials with high and low atomic number can produce an intense x-ray radiation with very narrow spectral peaks at the vicinity of K, L, ... atomic absorption edges of each of the materials. They propose selection rules for materials constituting the solid-state superlattice. Their results demonstrate that an inexpensive x-ray source with mega (or submega) electron volt energy of electron beam can be used to generate narrow-line x-ray radiation. 23 refs., 6 figs.

45813 VUV amplification of neon-like titanium ion. Yashiro, Hidehiko (Institute of Physical and Chemical Research, Saitama (Japan)); Hara, Tamio; Ando, Kozo; Aoyagi, Yoshinobu; Dote, Toshihiko; Namba, Susumu. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Amplified spontaneous emission of the $2p^53s^3P_1$-$2p^53p^3D_2$ transition at 50.8 nm in neon-like titanium ion has been observed in a line-shaped plasma produced by focusing a long laser pulse of 5 ns on a slab target for keeping population inversion for a long time. Laser produced plasmas have been applied to short wavelength laser studies because of including high density multiply charged ions. The electron collisional excitation of neon-like ions in the laser produced plasma is one of the pumping schemes of the short wavelength laser. 5 refs., 4 figs.

45814 X-ray laser research at Physics International. Deeney, C. (Physics International Company, San Leandro, CA (USA)); Levine, J.; Nash, T.; LePell, P.D.; Krishnan, M. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Photopumped and recombination x-ray laser schemes are under investigation at Physics International, on the DNA/PITHON 3 TW facility. For the sodium-neon resonant photopumped scheme, DNA/PITHON is used to implode a sodium-bearing plasma, the pump, and a secondary capacitor bank is used to drive a neon gas puff Z-pinch, the lasant. The characterization of the pinched sodium plasma is reported in this paper, as are pump power measurements, which showed 65 GW in the Na X $1s^2$-1s2; ^1P line. In earlier experiments, neon gas was imploded onto sodium-fluoride coated targets, on-axis, but insufficient sodium pump powers were obtained. However, some very interesting spectral features, which could be an indication of recombination pumping, were observed in the neon plasmas formed when neon was imploded onto aluminum targets. These results are also presented in this paper. 17 refs., 11 figs.

45815 Ultrahigh peak power pulses produced by Chirped Pulse Amplification. Maine, P. (Univ. of Rochester, NY (USA)); Strickland, D.; Bado, B.; Mourou, G. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Chirped Pulse Amplification (CPA) allows the amplification of short laser pulses in amplifying media with good storage properties (low transition cross section) like Nd:glass or Alexandrite. In these media, straight amplification cannot be performed well, because of the large input flux necessary to reach efficient energy extraction. This condition leads to unacceptable peak powers. To minimize the intensity effects, the pulse is stretched, amplified, and recompressed. This technique allows an efficient energy extraction while maintaining a good beam quality. Using this technique, the authors have been able to amplify single picosecond pulses to the joule level using a table-top system. The beam divergence has been measured to be two times the diffraction limit at the output of the system.

45816 Multiterawatt excimer laser system. Watanabe, S. (Univ. of Tokyo (Japan)); Endoh, A.; Watanabe, M.; Sarukura, N. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A peak power of 4 TW has been obtained in KrF with an output energy of 1.5 J in 390 fs from an electron-beam-pumped amplifier with an active cross section of 320 cm^2. The amplified spontaneous emission was as low as 1.8% in energy. The pulse width was measured by the newly-developed third-order autocorrelation technique based on the XeF C-A transition. An initial pulse width of 210 fs was increased to 390 fs through amplifiers. The process of the pulse width broadening was investigated in detail through dummy optics, the thickness of which coinsides with the entire system. The broadening was attributed mainly to the linear dispersion of thick optics for near-transform-limited input pulses. Nonlinear absorption and self-phase modulation were not significant in the output window of a 2.5-cm-thick CaF_2 at an intensity of 13 GW/cm^2. 17 refs., 12 figs.

45817 Narrowband tunable VUV/XUV radiation generated by frequency mixing of pulsed and cw laser radiation. Hilber, G. (Universitaet Hannover (Germany, F.R.)); Lago, A.; Wallenstein, R. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Four- and six-wave mixing of pulsed and cw laser radiation in gases generates coherent radiation in the spectral region of the VUV/XUV at 60 - 200 nm. Recently considerable experimental progress has been achieved towards the development of powerful coherent VUV/XUV light sources based on these nonlinear optical methods. The third-order resonant sum- and difference frequency mixing in Kr, for example, generates broadly tunable VUV/XUV radiation at wavelengths in the region of 70 - 200 nm. Because of the high efficiency, the reliability, and the experimental simplicity the conversion in Kr has the potential to become a standard method for the generation of frequency tunable VUV/XUV light. The frequency mixing of cw laser radiation produces frequency stable VUV radiation (at 140-200 nm) of narrow spectral width ($\Delta E < 3.10^{-5} cm^{-1}$). In contrast to the extensive experimental investigations the theoretical treatment of frequency mixing in gases was restricted mostly to special conditions (like homogeneous medium, equal confocal parameters, focii of the laser beams located at the same position, etc.). Using the integral method to solve the inhomogeneous Maxwell equation the authors were able to perform a rigorous theoretical analysis of the frequency mixing in gases. 3 refs.

45818 High efficiency, scalable, 130 nm coherent source by four-wave mixing in Hg vapor. Muller, C.H. III (Spectra Technology, Inc., Bellevue, WA (USA)); Hamilton, C.E.; Lowenthal, D.D.; Smith, A.V. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Coherent vacuum ultraviolet (VUV) pulses with energy 1.1 mJ, 3 ns pulse length (1.3 MW cm^{-2} unfocused), and measured bandwidth <0.1 cm^{-1} have been achieved using four-wave sum-frequency mixing in mercury vapor. High energy conversion efficiencies of 5 percent have been demonstrated in a collimated beam geometry over 1 meter interaction lengths. The 130 nm radiation is tunable over 2.5 cm^{-1}. The experimental facility assembled to produce this efficient VUV laser source will be described, and comparison between experimental measurements and theory are provided. 9 refs., 13 figs.

45819 Intense coherent radiation in the VUV and XUV region with electron beam pumped rare gas excimer lasers. Sasaki, Wataru (Univ. of Osaka Prefecture (Japan)); Kurosawa, Kou. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Rare gas excimer lasers are attractive sources for applications in laser spectroscopy, plasma diagnostics and photolytic pumping of other lasers. Since 1981, high-power rare-gas excimer lasers pumped by a pulsed electron beam have been developed, and their performance using tunable cavities has been studied. This report presents an overview of intense coherent sources in the VUV and XUV spectral region based on such excimer lasers and frequency conversion techniques of stimulated Raman scattering and anti-Stokes Raman laser pumping to extend the wavelength coverage. Three topics are emphasized: (1) Present status of rare gas excimer lasers in our laboratory; (2) Extension of the excimer laser wavelength coverage by stimulated Raman scattering in hydrogen molecules; (3) Discussion of anti-Stokes Raman lasing in group VI atoms with the aim to generate XUV radiation. 8 refs., 6 figs., 2 tabs.

45820 X-ray emission studies of sub-picosecond laser produced plasmas. Murnane, M.M. (Univ. of California, Berkeley (USA)); Kapteyn, H.C.; Falcone, R.W. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors report on both experimental and theoretical studies of high-temperature, high-density plasmas produced when a solid is illuminated with intense, 160 femtosecond laser pulses. Time resolved measurements have determined the x-ray pulsewidth from the plasma to be 2 ± 2 psec in all spectral regions up to a kilovolt. Spectroscopic observations demonstrate that the x-ray emission comes from regions of density higher than those found in a conventional laser produced plasma. Finally reflectivity measurements indicate that the laser is absorbed at the surface of the solid before it expands. 21 refs., 7 figs.

45821 Current prospects for free-electron lasers in the extreme ultraviolet. Newnam, B.E. (Los Alamos National Lab., NM (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

In the last few years, free-electron laser (FEL) oscillators and amplifiers have produced coherent radiation over a broad spectral range extending from 463 nm in the visible to millimeter wavelengths. These successful demonstrations have encouraged a number of research centers to boldly consider extension of this electron-accelerator-based technology to the extreme ultraviolet (XUV) below 100 nm where no powerful, tunable, coherent-radiation source presently exists. Here, the peak- and average-power output of FEL oscillators and amplifiers should surpass the capabilities of any existing, continuously tunable photon sources by many orders of magnitude. Extending FELs to ever shorter wavelengths, however, is inherently difficult since the gain decreases monotonically with the square-root of the wavelength, and below 100 nm the available mirrors for resonators have comparatively low reflectance, generally $\leq$50%. With such mirrors, the small-signal power gain for a single pass through the magnetic undulator must exceed 400% just to reach the threshold for oscillation. Increased gain can be attained with long undulators comprising several hundred periods and jpeak current of $\geq$100 A. However, long undulators have reduced homogeneous gain bandwidth equal to 1/4N, where N is the number of periods. Since the gain is decreased by transverse beam emittance and longitudinal energy spread, it is essential that the accelerators deliver very bright electron beams. Storage rings and rf-linear accelerators, appear to be the only sources of electron beams with brightness adequate for XUV FELs. The proposed FEL schemes include oscillators using optical resonators, single-pass amplifiers based on self-amplification of spontaneous emission (SASE), multiple-pass regenerative amplifiers, and optical klystrons in which electrons bunched by external lasers radiate coherent harmonics.

45822 Compact x-ray free-electron laser. Barletta, W. (Univ. of California, Los Angeles (USA)); Atac, M.; Bhowmik, A.; Bobbs, B.;

Cline, D.B.; Cover, R.A.; Dixon, F.P.; Gallardo, J.; Kolonko, J.; Pellegrini, C.; Rakowsky, G.; Wang, X.; Westenskow, G. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors present a design concept and simulation of the performance of a compact x-ray, free electron laser driven by ultra-high gradient rf-linacs. The accelerator design is based on recent advances in high gradient technology by a LLNL/SLAC/LBL collaboration and on the development of bright, high current electron sources by BNL and LANL. The GeV electron beams generated with such accelerators can be converted to soft x-rays in the range from 2 - 10 nm by passage through short period, high field strength wigglers as are being designed at Rocketdyne. Linear light sources of this type can produce trains of picosecond (or shorter) pulses of extremely high spectral brilliance suitable for flash holography of biological specimens in vivo and for studies of fast chemical reactions. 12 refs., 8 figs., 4 tabs.

45823 Targets for efficient femtosecond-time-scale x-ray generation. Kmetec, J.D. (Stanford Univ., CA (USA)); Harris, S.E. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

High power femtosecond lasers can be used to generate bright x-ray sources. The choice of element for the laser-produced-plasma target strongly affects the nature of the emitted x-rays. Combining low Z and high Z elements results in the brightest femtosecond x-ray radiators. Examples of lithium and tin combinations yielding 3.6 Å x-rays with up to several percent conversion efficiencies are given. 9 refs., 4 figs.

45824 Strong-field processes in the ultraviolet region. Boyer, K. (Univ. of Illinois, Chicago (USA)); Gibson, G.; Jara, H.; Luk, T.S.; McIntyre, I.A.; McPherson, A.; Rosman, R.; Solem, J.C.; Rhodes, C.K. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A laboratory means for the generation of ultrahigh energy density states of matter, corresponding approximately to 0.1 - 1.0 W/atom at solid density, appears within technological reach. This capability enables the production, in a convenient laboratory environment, of energy densities comparable to those occurring in stellar interiors. The use of this technology will permit the study of a new realm of atomic phenomena involving (1) the behavior of matter in very strong fields, (2) the properties of highly stripped ions, (3) the characteristics of dense highly non-equilibrium plasmas, (4) high-field modes of electromagnetic propagation, and (5) the possibility of a new laser-driven means for the excitation and control of nuclear reactions. 34 refs., 2 figs., 2 tabs.

45825 Multiphoton ionization for the production of x-ray laser plasmas. Corkum, P.B. (National Research Council of Canada, Ottawa, Ontario); Burnett, N.H. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

In the long wavelength (or high intensity) limit, above threshold ionization (ATI) is primarily the result of the interaction of a newly freed electron with the laser field. A classical model of ATI predicts that the energy of a newly released electron can be controlled by varying the laser wavelength and polarization. Similar predictions are made by Keldysh-style theories. Measurements, performed using both linearly and circularly polarized picosecond 10 μm pulses, confirm these conclusions. Cold, high-Z plasmas for recombination XUV lasers can be produced by multiphoton ionization with linearly polarized visible or UV radiation. Hot electrons, potentially suitable for electron-pumping of ionization-phase XUV lasers can be produced using longer wavelength or circularly polarized light. 20 refs., 5 figs.

45826 Charge-displacement self-channeling as a method for energy concentration. Boyer, K. (Univ. of Illinois, Chicago (USA)); Luk, T.S.; Solem, J.C.; Rhodes, C.K. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The concentration of energy arising from charge-displacement self-channeling is discussed. Since high energy deposition rates are expected to arise from multiphoton coupling and the channel can also serve as an effective waveguide for secondary radiation, such circumstances are ideal for generating coherent short wavelength radiation. 11 refs., 2 figs.

45827 Reflectance of aluminum reflectors in the extreme ultraviolet. Scott, M.L. (Los Alamos National Lab., NM (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The author has investigated a new concept in retro-reflectors for use in the extreme ultraviolet, namely, UHV aluminum coated, multifacet, grazing-incidence mirrors. The results indicate that this type of mirror, which utilizes total-external-reflectance, works very well in the wavelength range from 35 nm to 100 nm (89 $\pm$ 3% measured retroreflectance at 58.4 nm for a 9-facet mirror). However, the coated mirror surfaces must not be allowed to oxidize after deposition, which implies that the retro-reflector must be coated and used in situ or the oxide layer must be removed in a ultra-high vacuum (UHV) system.

45828 Effectiveness of metal-coated diffraction gratings at grazing and near normal incidence as harmonic scrubbers. Wantuck, P.J. (Los Alamos National Lab., NM (USA)); Appert, Q.D.; Tong, K.; Pistoresi, D.J. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

High power free electron lasers (FEL) can produce significant amounts of harmonic radiation. These harmonic components represent a substantial damage threat to the optical elements comprising the laser resonator. In this paper the authors discuss the merits of using blind gratings in both the paraboloid and grazing incidence hyperboloid mirrors of a 1.06-micron FEL under construction by the Boeing Aerospace Company. Grating designs developed for use at grazing incidence are not very efficient for dispersing the harmonics. However, blind gratings positioned in the paraboloid exhibit better filtering capability. 6 refs., 8 figs., 3 tabs.

45829 Proposed method for the measurement of the spatial coherence of laboratory x-ray lasers. Trebes, J. (Lawrence Livermore National Lab., CA (USA)); Barbee, T.; Nathel, H.; Szoke, A. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A proposed method of measuring the spatial coherence length of laboratory x-ray lasers is described. The method is based on the coherence dependent interference pattern produced by double slit arrays. The neon-like Se laser at 208 Å is used as an example. 6 refs., 4 figs., 1 tab.

45830 Coplanar vacuum photodiode for measurement of short-wavelength picosecond pulses. Bokor, J. (AT & T Bell Laboratories, Holmdel, NJ (USA)); Johnson, A.M.; Simpson, W.M.; Storz, R.H. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A vacuum photodiode is the most elementary photoelectric detector. Such a device is sensitive to photon energies which exceed the photocathode work function in accord with the classical photoelectric effect. For vacuum ultraviolet and soft x-ray radiation, photoelectric quantum yields in excess of 50% can be reached. With a carefully designed external circuit, the response time of such a detector is limited by the diode capacitance. The present state-of-the-art risetime in a commercial biplanar vacuum photodiode is 60 psec. Recent studies have demonstrated the utility of the coplanar transmission line geometry with lateral dimensions of several micrometers for the generation and propagation of picosecond electrical pulses. The authors have realized an ultrafast vacuum photodiode detector by taking advantage of a microfabricated coplanar stripline geometry. Two parallel stripline electrodes themselves serve as the photocathode and collection anode. A representation of our initial devices is shown. In the application primarily envisioned for this device, namely the measurement of short soft x-ray pulses radiated by picosecond laser plasma sources, the photodiode is optimized to give high sensitivity for soft x-rays, while a small portion of the pump laser pulse used to create the plasma is also used to trigger a conventional photoconductive sampler in order to read out the photodiode pulse. The device has been tested using 266 nm ultraviolet (UV) laser pulses of ~ 500 fsec duration derived from a compressed, mode-locked Nd:YAG laser. With 60 V applied bias, a 4 psec risetime and a 12 psec fall time is obtained. It was not possible to apply a higher bias voltage to this device due to avalanche breakdown of the silicon between the lines. By improving the device processing to eliminate the silicon between the striplines, higher bias voltage and hence higher speed should be obtained. 3 refs., 2 figs.

45831 X-ray optics for x-ray laser research applications. Ceglio, N.M. (Univ. of California, Livermore (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

State of the art capabilities in soft x-ray lenses, multilayer mirrors, beamsplitters, and synthetically generated holograms are reviewed. Application of these capabilities in recent x-ray laser cavity experiments, and to the development of a soft x-ray interferometer and a high intensity $\gtrsim 10^{13}$ watt/cm^2 soft x-ray laser are discussed. 39 refs., 7 figs., 1 tab.

45832 Non-reciprocity of autoionizing interferences: Lasers without inversion. Harris, S.E. (Stanford Univ., CA (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Interferences of autoionizing lines may reduce or eliminate absorption of lower level atoms. Stimulated emission shows no such interferences, thereby allowing laser gain without population inversion. 9 refs., 3 figs.

45833 (DOE/ER/13309–4) **Research in x-ray optics with the ultimate aim of constructing a synchrotron radiation pumped soft x-ray lithium laser: Final report.** Csonka, P.L. Oregon Univ., Eugene, OR (USA). Inst. of Theoretical Science. 31 Aug 1988. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract FG06-85ER13309. Order Number DE89016788/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

One of the primary components of the proposed synchrotron radiation (SR) pumped Li X-Ray Laser which the present research (DOE Proposal No. DE-FG06-85ER-13309) undertook to develop, was a vacuum-based high density plasma of predominantly monatomic Lithium as the lasing medium. A monomer density in excess of 10^{19} particles/cm^3 at temperatures > 1600°C, in volume of roughly 1cm x 0.001cm x 0.001cm was estimated as being necessary for attaining useful gain. Originally two different methods of achieving this were considered, namely: laser-driven ablation of solid Li, and steady-state thermal emission of Li gas from an orifice in a suitable chamber. Due to uncertainties associated with the first option, the resources of the present development program were focused primarily on the latter technique. 9 figs.

45834 (LA-UR–89-2938) **Los Alamos High-Brightness Accelerator FEL (HIBAF) facility.** CXornelius, W.D.; Bender, S.; Meier, K.; Thode, L.E.; Watson, J.M. Los Alamos National Lab., NM (USA). [1989]. 15p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-8908134–3: 11. international free electron laser conference, 28 Aug - 1 sep 1989). Order Number DE89016729/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The 10-μm Los Alamos free-electron laser (FEL) facility is being upgraded. The conventional electron gun and bunchers have been replaced with a much more compact 6-MeV photoinjector accelerator. By adding existing parts from previous experiments, the primary beam energy will be doubled to 40 MeV. With the existing 1-m wiggler (λ_w = 2.7 cm) and resonator, the facility can produce photons with wavelengths from 3 to 100 μm when lasing on the fundamental mode and produce photons in the visible spectrum with short-period wigglers or harmonic operation. After installation of a 150° bend, a second wiggler will be added as an amplifier. The installation of laser transport tubes between the accelerator vault and an upstairs laboratory will provide experimenters with a radiation-free environment for experiments. Although the initial experimental program of the upgraded facility will be to test the single accelerator-master oscillator/power amplifier configuration, some portion of the operational time of the facility can be dedicated to user experiments. 13 refs., 5 figs., 6 tabs.

45835 (ORNL/FTR–3218) **[Synchrotron radiation, free electron laser, and nuclear structure]: Foreign trip report, April 6, 1989–April 13, 1989.** Olson, D.K. Oak Ridge National Lab., TN (USA). 1 May 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017352/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler attended the CERN Accelerator School and Daresbury Laboratory course on Synchrotron Radiation and Free Electron Lasers held at Chester College, Chester, England, from April 6 to 13, 1989. The course, attended by 89 people, was well conceived, well presented, and informative. Almost all aspects of accelerator-based light sources were discussed. The traveler also visited the Nuclear Structure Facility at Daresbury Laboratory, Daresbury, England. The tandem accelerator of the Nuclear Structure Facility runs routinely between 18 and 19 MV and, with difficulty, between 19 and 20 MV. Installation of the Oxford post-tandem superconducting rf cavities is nearly complete. These cavities will increase the effective accelerating potential by about 6 MV. In addition, Daresbury plans to add another 6 MV of superconducting rf cavities. When complete, the Daresbury tandem facility should be able, with three foil strippings, to accelerate lead to 5 MeV/nucleon.

45836 (SAND–89-1056C) **Acceleration of thin foil targets using fiber-coupled optical pulses.** Trott, W.M.; Meeks, K.D. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–13: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016526/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Commercially available optical fibers can reliably transmit Nd:Glass laser pulses of high irradiance (>3.5 GW cm^{-2}) without damage. The optical energy at the fiber output can be used for efficient acceleration of thin foil targets. An optically recording velocity interferometer system (ORVIS) has been used to determine velocity-time histories for aluminum foils accelerated in this manner. Flyer performance has been examined as a function of laser energy and pulse duration. The measured velocities indicate that the efficiency of coupling optical energy into flyer kinetic energy can be as high as 35 percent. For 0.005-mm-thick Al coupled to a 0.4-mm-diameter fiber, foil velocities >3 km s^{-1} have been achieved with modest laser energies (<30 mJ). Preliminary results of particle velocity measurements on flyer-impacted witness plates are also given. 15 refs., 6 figs.

45837 Laser performance of $LiSrAlF_6:Cr^{3+}$. Payne, S. A. (University of California, Lawrence Livermore National Laboratory, P.O. Box 5508, L-490, Livermore, California 94550(US)); Chase, L. L.; Smith, L. K.; Kway, W. L.; Newkirk, H. W. *Journal of Applied*

Physics (USA), 66(3): 1051-1056 (1 Aug 1989). DOE Contract W-7405-ENG-48.

We have lased the new material, $LiSrAlF_6:Cr^{3+}$ (Cr^{3+}:LiSAF). The single crystals were grown by the horizontal zone melting technique. The spectroscopic properties of Cr^{3+}:LiSAF are similar to those of other low-field Cr^{3+}-doped systems, although the emission cross section is strongly π polarized and is also somewhat larger than has been measured for other fluoride hosts. The free-running lasing wavelength of Cr^{3+}:LiSAF is 825 nm, and the tuning range extends from at least 780 to 920 nm. Using Kr laser pumping, we obtained slope efficiencies of 36% and 14% by utilizing output couplings of 4.8% and 0.8%, respectively. On the basis of these results, the extrapolated maximum efficiency of 53% is determined, to be compared to the quantum defect-limited value of 78%. It is concluded that a moderate level of excited state absorption (ESA) loss is responsible for the reduced efficiency of the Cr^{3+}:LiSAF system. This contrasts with the related results previously obtained for $LiCaAlF_6:Cr^{3+}$, where it was concluded that the effects of ESA were negligible [IEEE J. Quantum Electron. **QE-24**, 2243 (1988)].

45838 Density gradient free electron collisionally excited X-ray laser. Campbell, E.M.; Rosen, M.D. To Dept. of Energy, Washington, DC. USA Patent 4,827,479. 2 May 1989. Filed date 29 Nov 1984. 13p. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

An operational X-ray laser (30) is provided that amplifies 3p-3s transition X-ray radiation along an approximately linear path. The X-ray laser (30) is driven by a high power optical laser. The driving line focused optical laser beam (32) illuminates a free-standing thin foil (34) that may be associated with a substrate (36) for improved structural integrity. This illumination produces a generally cylindrically shaped plasma having an essentially uniform electron density and temperature, that exists over a long period of time, and provides the X-ray lase gain medium. The X-ray laser (30) may be driven by more than one optical laser beam (32, 44). The X-ray laser (30) has been successfully demonstrated to function in a series of experimental tests.

4204 Heat Transfer and Fluid Flow

Refer also to citation(s) 45032, 45149, 45374, 45702, 45741, 45748, 46025

45839 (AD-A-207811/1/XAB) **Heat transfer and fluid dynamics of concave-surface curvature. Final report, 1 January 1986-31 December 1988.** Bradshaw, P.; Johnston, J.P.; Moffat, R.J. Stanford Univ., CA (USA). Dept. of Mechanical Engineering. 21 Apr 1988. 20p. Available from NTIS, PC A03/MF A01.

This project investigated the mechanisms responsible for the known increases in shear stress and convective heat transfer when a turbulent boundary layer flows over a concave wall compared to a similar flow over a flat wall. The effects of grid-generated Free-Stream Turbulence (FST level< or = 7.5%) were also examined for flat and concave-wall TBL's. The work was conducted in a large scale boundary layer using low-speed water flow. Momentum thickness Re was = 1400. Surface heat-transfer rate was measured with a constant-temperature metal surface and by use of a liquid-crystal surface. Temperature profiles were obtained by miniature thermocouple probe down to y+ = 3 and all three velocity components by a 3-D, laser velocimeter down to y+ = 7. Heat transfer and wall shear stress were both found to be augmented by curvature and free-stream turbulence applied separately, but the combined effect of curvature and FST is not simply the sum of the individual effects. In the case of wall stress, the effects of curvature are much larger than FST effects once the flow develops downstream. The nature of the interaction is being investigated using a working hypothesis based on the ideas of active (Reynolds stress producing) and inactive can stimulate only a limited increase (order 25%) in wall friction coefficient. However, for the moderate levels of FST used in this study, no such saturation process exists to limit the increase in surface heat-transfer rate.

45840 (IC–89/7) **Inverse problem for a nonlinear porous media equation.** Shidfar, A.; Mohseni, K. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 12p. Order Number DE89636429/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The problem to be discussed in this article pertains to the flow of fluid through one-dimensional porous media in which the diffusivity coefficient of the medium depends in an unknown manner on the volumetric moisture content. Specifically, we use Schauder's fixed point theorem to conclude that an appropriate unique solution to this problem exists. (author). 15 refs.

45841 (IC–89/30) **On the thermal stability of flow of a radiating two-component plasma in a porous medium between two rotating cylinders.** Bestman, A.R. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 14p. Order Number DE89636426/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This paper studies the effect of magnetic field on the convective instability of a radiating fluid in a porous medium confined between two rotating cylinders. The temperature of the walls of the cylinders are large but the temperature difference is small so that the radiative flux equation could be linearized. Only for very small radiation parameter, of order 0(0.01), does instability first set in via adverse temperature gradient. Otherwise rotational instability is more fatal. (author). 4 refs, 1 tab.

45842 (IC–89/31) **Radiative effect on the thermal instability of flow in a porous medium between two rotating cylinders.** Bestman, A.R. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 15p. Order Number DE89636427/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The combined effect of rotation and heating on the thermal stability of flow in a porous medium is studied when the temperatures involved are large for radiative heat transfer to be significant. The porous medium is confined between two rotating cylinders and both the angular velocity and temperature of the inner cylinder are higher than those of the outer. Hence instability can set in either as a result of unfavourable distribution of thermal gradient or angular momentum gradient. In this study rotational instability sets in first, under normal conditions, and this can be contrasted with the case in which radiative heat transfer is absent and thermal instability is more fatal. (author). 9 refs, 1 tab.

45843 (IC–89/32) **Natural convection boundary layer with suction and mass transfer in a porous medium.** Bestman, A.R. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 13p. Order Number DE89636428/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The free convection boundary layer flow with simultaneous heat and mass transfer in a porous medium is studied when the boundary wall moves in its own plane with suction. The study also incorporates chemical reaction for the very simple model of a binary reaction with Arrhenius activation energy. For large suction asymptotic approximate solutions are obtained for the flow variables for various values of the activation energy. (author). 10 refs, 2 figs.

45844 (INIS-BR–1578) **Experimental determination of the fluid velocity by spectral analysis of temperature fluctuations.** Foucrier, M.J.; Faya, A.J.G. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (In Portuguese). (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89636430/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Local velocities of turbulent closed channel flow were measured applying the noise analysis technique to signals coming from two sensors separated by a know distance. Good agreement was found when comparing experimental data to more accurate measurements. Ranges of Reynolds number and thermocouple spacial separation are recommended. (author).

45845 (INIS-BR–1579) **Laminar forced convection inside externally finned tubes.** Santos, C.A.C.; Cotta, R.M.; Ozisik, M.N. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89636431/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Analytical solutions are obtained for thermal entry region problems inside ducts with axially varying heat transFer coefficient, by

making use of the ideas in the recently advanced generalized integral transform technique. The analysis is applied to stepwise variations of Biot number that simulate intermitent rows of external fins. Numerical results are obtained for different fin arrangements, in a systematic manner, so as to critically examine the relative marits of wider and/or more numerous fin rows. (author).

45846 (INIS-BR–1580) **Thermal analysis of a mix up sodium tank and its ebb pipeline for SS-050 circuit during a thermal shock.** Jesus Miranda, C.A. de; Gebrim, A.N. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (In Portuguese). (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89636432/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In this work a thermo-hydraulic model was developed in order to obtain the sodium temperature time history between the mixup tank (TM) and the drain tank of the SS-050 sodium test loop. Results are presented relative to a thermal shock whith initial and final sodium inlet temperature of 600^{0}C and 400^{0}C respectively, with a thermal gradient of-200^{0}C/s. This sodium loop will be briefly installed in the IEN/RJ area. From the sodium temperature time-history during the thermal shock transient the temperature field for the walls of the TM bottom and outlet nozzle is obtained. (author).

45847 (INIS-BR–1581) **Investigation of loads generated by temperature transients in pipes.** Maneschy, C.E. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89636433/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

An analysis is presented of the effect of a transient temperature on the stress distribution due to a fluid flowing through a pipe, is analytically determined using the definition of a variable called in this paper as "shifted time". This variable, which is related to the axial coordinate, the average fluid velocity and the real time, is defined to make the transient thermal problem one-dimensional. The stresses are then calculated from the temperature solution using the linear theory of viscoelasticity. (author).

45848 (INIS-BR–1605) **Natural convection in an adiabatic vertical channel due to a dissipated heat element.** Ramos, M.A.M.S. Pontificia Univ. Catolica do Rio de Janeiro, RJ (Brazil). Dept. de Engenharia Mecanica. 25 Apr 1986. 134p. (In Portuguese). Order Number DE89636434/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

An experimental study was perfomed on natural convection heat transfer to air in a vertical channel due to an isothermal heated element attached in one of the walls of the channel. The heated element dissipates heat due to the Joule effect. To determine the heat transfer coefficient, it is necessary to evaluate the heat transferred to air by natural convenction alone. Hence, the heat lost by the element due to conduction and radiation is evaluated in order to correct the measured heat transfer. The natural-convenction heat transfer coefficient is a function of the following parameters: the temperature difference between the element and the ambient air, the position of the element in the channel, and the channel spacing. An optimal value of the channel spacing, when the heat transfer coefficient attains its maximum value, was observed for each of the temperature difference investigated. These maximum values may be up to 25% higher than the value for the case of infinite spacing. Comparisons are made with results available in the literature for similar configurations, and the values found in this work are higher. (author).

45849 (LNCC–030/88) **And still, a new beginning: the Galerkin least-squares gradient method.** Franca, L.P.; Carmo, E.G.D. do. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Aug 1988. 34p. Order Number DE89636435/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A finite element method is proposed to solve a scalar singular diffusion problem. The method is constructed by adding to the standard Galerkin a mesh-dependent term obtained by taking the gradient of the Euler-lagrange equation and multiplying it by its least-squares. For the one-dimensional homogeneous problem the method is designed to develop nodal exact solution. An error estimate shows that the method converges optimaly for any value of the singular parameter. Numerical results demonstrate the good stability and accuracy properties of the method. (author).

45850 (LNCC–034/88) **Feed back Petrov-Galerkin methods for convection dominated problems.** Carmo, E.G.D. do; Galeao, A.C. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Sep 1988. 30p. Order Number DE89636436/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Petrov-Galerkin method is adaptively applied to convection dominated problems. To this end a feedback function is created which increases the control of derivatives in the direction of he gradient of the approximate solution. This leads to a method with good stability properties close to boundary layers and high accuracy in those regions where regular solutions do occur. (author).

45851 (LNCC–037/88) **New finite element formulation for CFD:VIII. The Galerkin/least-squares method for advective-diffusive equations.** Hughes, T.J.R.; Hulbert, G.M.; Franca, L.P. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Oct 1988. 35p. Order Number DE89636437/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Galerkin/least-squares finite element methods are presented for advective-diffusive equations. Galerkin/least-squares represents a conceptual simplification of SUPG, and is in fact applicable to a wide variety of other problem types. A convergence analysis and error estimates are presented. (author).

45852 (N–89-22353) **Spectral solution of the incompressible Navier-Stokes equations on the connection machine 2. Final report.** Tomboulian, S.; Streett, C.; Macaraeg, M. National Aeronautics and Space Administration, Hampton, VA (USA). Langley Research Center. Jan 1989. 11p. (NASA-CR–181770;NAS–1.26:181770;ICASE–89-1). Available from NTIS, PC A03/MF A01.

The issue of solving the time-dependent incompressible Navier-Stokes equations on the Connection Machine 2 is addressed, for the problem of transition to turbulence of the steady flow in a channel. The spectral algorithm used serially requires O(N(4)) operations when solving the equations on an N x N x N grid; using the massive parallelism of the CM, it becomes an O(N(2)) problem. Preliminary timings of the code, written in LISP, are included and compared with a corresponding code optimized for the Cray-2 for a 128 x 128 x 101 grid.

45853 (SAND–89-0271C) **Heat transfer characteristics of igniter output plumes.** Evans, N.A.; Durand, N.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909113–: 14. international pyrotechnics seminar, 18-22 Sep 1989). Order Number DE89011449/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Seven types of pyrotechnic igniters were each mounted at one end of a closed cylindrical bore hole representative of the center hole in a thermal battery. Measurements of local bore wall temperature, T_w, using commercially available, fast response (10 μsec) sheathed chromel-constantan thermocouples allowed calculation of local heat transfer rates, q, and wall heat flows, Q. The principal charge constituents of all these igniters were titanium and potassium perchlorate, while three types also contained barium styphnate as an ignition sensitizer. Igniter closure disc materials included glass-ceramic, glass, metal (plain, scored, with and without capture cone), and kapton/RTV. All igniters produced the lowest values of T_w and q at the beginning of the bore, and, except for the igniter with the kapton/RTV closure disc, these quantities increased with distance along the bore. For igniters containing only titanium/potassium perchlorate, the rates of increase of Q along the bore length, compared with those for T_w and q, were generally lower and more variable. The inclusion of barium styphnate produced rates of change in Q that were essentially constant to the end of the bore. The highest overall average wall temperatures were achieved by two igniter types with metal closure discs and no capture cone. No clear correlation was established between peak bore pressure and maximum wall temperature. 3 refs., 8 figs., 1 tab.

45854 **Shock loading structures using a blast tube.** Cherry, J.L. (Sandia National Labs., Livermore, CA (US)); Trinh, K.V. pp. 68 of Shock and wave propogation. Shin, V.S.; Kim, K.S. American

Society of Mechanical Engineers, New York, NY (1988). (CONF-8806211–: Shock and wave propagation, 19-23 Jun 1988).

A blast tube technique has been utilized to spot load targets with high-intensity, variable-duration pressure pulses. A combined experimental and analytical program is detailed which: 1) determines the spatial and temporal characteristics of the pressure pulse loading, and 2) validates a hydrodynamic computer code which can then be used to determine loading characteristics for similar blast tubes with different targets.

45855 New methods for locating phase boundaries. Fescos, G. (National Institute of Standards and Technology, Gaithersburg, MD (USA)); Kincaid, J.M.; Morrison, G. *International Journal of Thermophysics (USA)*, 10(1): 75-85 (Jan 1989). DOE Contract FG02-87ER13648. (CONF-880606–: 10. symposium on thermophysical properties, 20-23 Jun 1988).

A new geometric representation for the dew/bubble conditions of a special class of polydisperse fluids is used to develop series expansion representations for the location of the top of the dew/bubble and shadow curves and for an expansion around the top of the dew/bubble and shadow curves. An excellent approximation for the one-component van der Waals coexistence is given as a special illustration of the method.

4205 Materials Testing

Refer also to citation(s) 45075, 45473, 45482, 45498, 45539, 46026, 46033

45856 (CONF-890721–41) **A technique to correlate fractography with NDE [nondestructive evaluation] of small samples.** Vaitekunas, J.J.; Roberts, R.A.; Ellingson, W.A. Argonne National Lab., IL (USA). Dec 1988. 13p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From Joint ASME/JSME pressure vessel and piping conference; 23-27 Jul 1989. Order Number DE89016904/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Images are often produced from data obtained with nondestructive evaluation (NDE) techniques to take advantage of the human ability to visually detect patterns and changes in acquired data. An ultrasonic imaging technique was applied to detect flaws and predict failure locations in ceramic modulus-of-rupture (MOR) bars. After fracture and subsequent fractographic analysis, the ultrasonic NDE data were correlated with digitized optical images of the MOR bars to determine if the location of the failure-initiating flaw had been detected by the ultrasonic technique. This paper describes the microcomputer-based digital image processing method used to correlate the fractographic analysis with NDE data. An algorithm which can be used to implement the technique on most imaging workstations will be presented, along with results obtained with an IBM-PC. 4 refs., 6 figs.

45857 (CONF-890996–3) **Sensors for nondestructive testing and evaluation of materials.** Oak Ridge National Lab., TN (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Sensor's expo '89; 12-14 Sep 1989. Order Number DE89014763/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Basic principles, designs, and several applications are described for the use of ultrasonic and eddy-current sensors in the nondestructive testing and evaluation of materials. There are many other designs and applications that have been used beneficially, and custom designing can be done to address specific needs or problems. The technology provides important tools for process control, product acceptance and assurance of continued integrity after periods of service. 23 refs., 21 figs.

45858 (EMR/MTL–89-02) **Certified nondestructive testing personnel to Canadian General Standards Board. Supplementary list to December 31, 1988.** Canada Centre of Mineral and Energy Technology, Ottawa, ON (Canada). Metals Technology Labs. [1989]. 33p. (In English and French). (MICROLOG–89-02626). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report gives a supplementary list of employees of the Canada Centre for Mineral and Energy Technology who are deemed to be qualified in any of the following fields of nondestructive testing: industrial radiography, ultrasonics, magnetic particle, liquid penetrant, and eddy currents. 1 tab.

45859 (KCP–613-4100) **Desiccant moisture adsorption testing: Final report.** Woodburn, G.L.; Lane, M.A. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1989. 29p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. Order Number DE89015206/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An alternate method of conducting the acceptance testing for the moisture adsorption capacity and adsorption rate of desiccant materials has been evaluated. The method uses a dew point generator that replaces the sulfuric acid/water bath bubbler humidity generation method of military specifications MIL-D-3464 and MIL-D- 3716. The alternate method eliminates a potentially hazardous test setup, allows for unattended operation, and yields results equivalent to the sulfuric acid/water bath bubbler method. 3 refs.

45860 (OH/RD–88-2-K) **Non destructive examination of non metallic materials. Research needs and opportunities.** Braun, J.M. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 19p. (MICROLOG–89-02604). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A review of the current status of non-destructive examination (NDE) of nonmetallic materials was carried out to ascertain the possibilities for applications within Ontario Hydro's Materials Chemistry Section. The review has a dual focus to identify both the more promising application domains amenable to NDE and the techniques likely to be of assistance in the evaluation, characterization, and assessment of nonmetallics, initially in a laboratory setting but ultimately for field application. The representative applications include adhesion, (as encountered in sealants or coatings), strength testing of reinforced rubber (flexible seals) and reinforced plastic, and control of curing systems (radioactive waste forms). The recommended NDE techniques include thermography, ultrasonic inspection and radiography. Other more narrow techniques which could see limited applicability would be acoustic emission, microwave, and holographic interferometry. The necessary steps to develop an NDE program with due regard for existing expertise elsewhere in the Division are outlined. 40 refs.

45861 (VTT-TUTK–576) **Coatings in electrical contacts.** Nieminen, I.; Varjus, S.; Ronkainen, H. Valtion Teknillinen Tutkimuskeskus, Espoo (Finland). Jan 1989. 24p. (In Finnish). Order Number DE89787739/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

In this survey the suitability of titanium nitride (TiN) coatings for improving the wear resistance of electric connectors was studied. Traditional electroplated coatings and TiN-coatings prepared by an ion plating method were compared in the tests. Wear and contact resistance measurements were performed by modifying a scratch tester usually used for adhesion determination. Titanium nitride had a better wear resistance than gold, but contact resistance values for TiN-coated samples were not low enough for electro-mechanical components. It was not possible to prepare ion plated coatings on copper samples used in electric connectors.

4208 Electronic Circuits and Devices

Refer also to citation(s) 45329, 45330, 45331, 45366, 45489, 45490, 45526, 45559, 45566, 45991, 46769

45862 (AD-A–207921/8/XAB) **Laser-induced diode linking for wafer-scale integration. Technical report.** Cohen, S.S.; Wyatt, P.W.; Chapman, G.H.; Canter, J.M. Massachusetts Inst. of Tech., Lexington, MA (USA). Lincoln Lab. 16 Mar 1989. 195p. (TR–820). Available from NTIS, PC A09/MF A01.

The use of laser-beam melting of silicon for the purpose of forming electrical links between two adjacent diodes is studied. The

diodes, which are formed by ion implantation and diffusion in a conventional CMOS process, are positioned such that when desired they may be used to obtain an electrical link between two otherwise separated sections of the integrated circuit. Electrical connections so obtained enable the realization of wafer-scale ICs, as demonstrated in recent applications. The theory of laser-beam application to silicon is discussed, and the various beam and substrate parameters are shown to affect the properties of the diode links. Particular attention is paid to the important issue of the reflectivity from the composite system. Careful analytical examinations of the resulting molten-zone properties were performed in order to fully qualify the use of laser radiation in this technology. Both scanning electron microscopy and secondary-ion mass spectrometry were used to examine such parameters as the lateral and in-depth extension of the molten zone. In addition, electrical measurements were carried out. The results for the various observables compare well with the theoretical predictions.

45863 X-ray microscopy for the life and physical sciences. Attwood, D. (Univ. of California, Berkeley (USA)); Vladimirsky, Y.; Kern, D.; Meyer-Ilse, W.; Kirz, J.; Rothman, S.; Rarback, H.; Iskander, N.; McQuaid, K.; Ade, H.; Chang, T.H.P. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract AC03-76SF00098;AC02-76CH00016. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Advances in x-ray microscopy coupled with the development of bright, partially coherent radiation at x-ray wavelengths, herald a new period in which scientists in diverse disciplines will use x-ray imaging and probing techniques to see ever smaller structures, write ever smaller patterns, and study physical, chemical and biological systems, not only with an elemental sensitivity, but in many cases with a sensitivity to details of bonding. The combination of x-ray microscopy and various emission spectroscopies will permit the study of surfaces, thin films and material interfaces, as well as biological samples in their natural, unaltered and hydrated state. In this brief report the authors describe two recent x-ray microscopy experiments which demonstrate achievement of significant milestones in the development of high spatial resolution x-ray microscopy for the life and physical sciences. In one series of experiments it was clearly demonstrated that x-ray optical systems are capable of forming images of nanostructure patterns associated with future microelectronic devices, to a spatial resolution better than 0.1 microns. In the second set of experiments, unaltered biological material was imaged in its natural state without recourse to sectioning, staining, fixing or drying, at a spatial resolution well beyond that of the optical microscope, and with a delivered energy dose well below that of an electron microscope. 11 refs., 3 figs.

45864 (FNAL-TM–1606) **A new semicustom integrated bipolar amplifier for silicon strip detectors.** Zimmerman, T. Fermi National Accelerator Lab., Batavia, IL (USA). 11 Jul 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89015585/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The QPA02 is a four channel DC coupled two stage transimpedance amplifier designed at Fermilab on a semicustom linear array (Quickchip 2S) manufactured by Tektronix. The chip was developed as a silicon strip amplifier but may have other applications as well. Each channel consists of a preamplifier and a second stage amplifier/sharper with differential output which can directly drive a transmission line (90 to 140 ohms). External bypass capacitors are the only discrete components required. QPA02 has been tested and demonstrated to be an effective silicon strip amplifier. Other applications may exist which can use this amplifier or a modified version of this amplifier. For example, another design is now in progress for a wire chamber amplifier, QPA03, to be reported later. Only a relatively small effort was required to modify the design and layout for this application. 11 figs.

45865 (KCP–613-4076) **Electronic encapsulation using foam with bonded metal covers for a filter pack: Final report.** Davis, L.C. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1989. 20p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. Order Number DE89014010/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This process investigation evaluated the feasibility of bonded metal covers to polyurethane foam in there non-electromagnetic radiation areas of a Filter Pack. This process would replace an epoxy microballoon encapsulation process presently used. Encapsulation samples and mock units underwent temperature and moisture testing for comparison against other similar processes and durability testing of adhesion. 1 fig., 7 tabs.

45866 (KCP–613-4081) **A robotic electrical and tensile testing system for diodes.** Darner, G.S. Allied-Signal Aerospace Co., Kansas City, MO (USA). Kansas City Div. Jul 1989. 15p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00613. Order Number DE89014012/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A robotic system was developed to automate the die attachment electrical testing performed on a specific diode. An industrial robot was integrated with electrical test equipment and a non-destructive tensile tester to verify the integrity of the lead attachment to the diode die. Robotic manipulation is employed to route the diodes through the testing and bin sorting operations. 4 refs., 6 figs.

45867 (SAND–88-1765) **A comparison of fixed-base and driven-base modal testing of an electronics package.** Carne, T.G.; Martinez, D.R.; Nord, A.R. Sandia National Labs., Albuquerque, NM (USA). Aug 1989. 27p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89016673/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper compares results for a fixed-base and a driven-base modal test of an electronics package. A fixed-base modal test uses the common testing procedure of attaching the structure to a large inertial mass which is freely suspended. The problem with this approach is that the input levels are typically limited by the strength of the structure and stinger attachment. An attractive alternative to fixed-base modal testing is to use high force shaker-tables to provide a driven-base input. Some of the issues of concern are: properly simulating the fixed boundary conditions, applying modal estimation algorithms to motion-to-motion frequency response functions vs. motion-to-force frequency response functions, non-linearity effects and testing at very low input levels vs. levels equal to those of the field environment, complications involved with shaker resonances, exciting the "response-critical" modes of the structure, and consistency of the modal parameters using driven-base tests vs. fixed-base modal tests. Experimental results are presented which demonstrate the adequacy of using vibration shake tables to excite the fixed-based modes of the system. A direct comparison of the modes acquired using fixed-base and driven-base excitation for the electronics package shows very close agreement. A discussion of the theory for driven-base testing is given, as well as a brief presentation of analytical predictions for the structure. 4 refs., 11 figs., 1 tab.

45868 (SAND–89-0544C) **Mechanical states in wound capacitors: Part 1, Prediction.** Reuter, R.C. Jr.; Allen, J.J. Sandia National Labs., Albuquerque, NM (USA). 1989. 20p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC04-76DP00789. (CONF-890987–1: ASME design conference, 17-20 Sep 1989). Order Number DE89008110/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The problem of determining the mechanical states inside wound capacitor rolls is addressed through the application of two dimensional, linear elasticity. Allowances are made for heterogeneous wound construction of the capacitor, orthotropic material behavior of the capacitor constituents, and arbitrary winding tension. A key element in the formulation is the derivation of material properties for a wound, orthotropic layer which is equivalent in behavior to a stack of dissimilar plies such as are actually wound on the capacitor simultaneously during one turn of the mandrel. The dissimilar plies are necessary by virtue of the conductor and dielectric materials which must be present in a capacitor. The derivation of predictive equations is based on winding the equivalent layer on an appropriate mandrel, followed by a recovery of the individual ply responses. The capability to explicitly calculate the winding tensions which

would be necessary to produce a required wound tension dependence upon capacitor radius is also developed. Numerical results for typical capacitor design and construction are presented, and justification for the application of optimization theory in capacitor development is demonstrated. 4 refs., 5 figs.

45869 (SAND–89-0841C) **ASIC [Application Specific Integrated Circuit] replacement for an SSI [Small Scale Integrated] component design a case study.** Everts, J.; Gelet, D.; Deatherage, D.; Contreras, M. Sandia National Labs., Albuquerque, NM (USA). 1989. 18p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909146–1: 2. annual IEEE/ASIC seminar and exhibit, 25-28 Sep 1989). Order Number DE89013494/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This case study covers the practical issues of design-for- functionality, design-for-simulation, and design-for-testability in replacing aging SSI component designs with ASIC gate arrays. The replacement of a 169-TTL-component design with a CMOS ASIC gate array is presented. Maintaining existing functionality is accomplished through a series of ordered conversion steps that minimize the probability of error in the conversion. Design modifications, such as the addition of initialization circuitry, were necessary to take advantage of CAE simulation tools. The faster ASIC technology coupled with design modifications allowed the time-to-simulate to be decreased by a factor of 10,000. A unique pseudo-random number generation/signature analysis technique is presented that interrogates highly sequential designs. The testability scheme and other design techniques improved stuck-at fault coverage by more than 640%. The economic advantages, knowledge gained, and the tools developed that are applicable to future design work are also discussed. 12 figs.

45870 (SAND–89-1625C) **Circuit level modeling of inductive elements.** Muyshondt, G.P.; Portnoy, W.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890815–18: 24. intersociety energy conversion engineering conference, 6-11 Aug 1989). Order Number DE89015122/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Design and analysis of spacecraft power systems have been difficult to perform because of the lack of circuit level models for nonlinear inductive elements. This paper reviews some of the models which have been proposed, their limitations, and applications. An improved saturation dependent model will be described. The model has been implemented in SPICE and with a commercial circuit program and demonstrated to be satisfactory in both implementations. 3 refs., 9 figs.

45871 (UCRL–100525) **Micro-cavity integrable vacuum diodes and triodes.** Orvis, W.J.; McConaghy, C.F.; Ciarlo, D.R.; Yee, J.H.; Hee, E.W.; Hunt, C.E.; Trujillo, J. Lawrence Livermore National Lab., CA (USA). Jul 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907121–1: 2. international conference on vacuum microelectronics, 24-26 Jul 1989). Order Number DE89016649/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We are developing miniature, vacuum, field emission diodes, and triodes for use in electronics in hazardous environments. We have produced the structures for micrometer sized diodes and triodes. We are currently improving the emission rate of the field mission electron source, before inserting it into the diode and triode structures. 3 refs., 6 figs.

45872 Modular multimorphic kinematic arm structure and pitch and yaw joint for same. Martin, H.L.; Williams, D.M.; Holt, W.E. To Dept. of Energy, Washington, DC. USA Patent 4,828,453. 9 May 1989. Filed date 21 Apr 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A multimorphic kinematic manipulator arm is provided with seven degrees of freedom and modular kinematic redundancy through identical pitch/yaw, shoulder, elbow and wrist joints and a wrist roll device at the wrist joint, which further provides to the manipulator arm an obstacle avoidance capability. The modular pitch/yaw joints are traction drive devices which provide backlash free operation with smooth torque transmission and enhance rigidity. A dual input drive arrangement is provided for each joint resulting in a reduction of the load required to be assumed by each drive and providing selective pitch and yaw motions by control of the relative rotational directions of the input drive.

45873 Method for controlling gas metal arc welding. Smartt, H.B.; Einerson, C.J.; Watkins, A.D. To Dept. of Energy, Washington, DC. USA Patent 4,825,038. 25 Apr 1989. Filed date 10 Aug 1987. 9p. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

The heat input and mass input in a Gas Metal Arc welding process are controlled by a method that comprises calculating appropriate values for weld speed, filler wire feed rate and an expected value for the welding current by algorithmic function means, applying such values for weld speed and filler wire feed rate to the welding process, measuring the welding current, comparing the measured current to the calculated current, using the comparison to calculate corrections for the weld speed and filler wire feed rate, and applying corrections.

4210 Combustion Systems

Refer also to citation(s) 44860, 44861, 44862, 44864, 44866, 44868, 44999, 45441, 45751

45874 (CMHC–870120) **Residential combustion venting failure. A systems approach. Final technical report. Project 5: Remedial measures for wood-burning fireplaces.** Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1987. vp. (CE–02736). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report is a review of remedial measures available for avoiding or correcting combustion venting problems in wood-burning fireplaces and included on account of field tests of airtight doors with direct air supply and of a fireplace spillage advisor. It appeared that properly designed, truly airtight doors are effective in isolating fireplaces from the house indoor pressure regime and that this remedial measure does not affect the fire safety of the fireplace. It was also found that the detection of smoke particles was effective when the fire was hot and flaming, but not during the smoldering stage of the fire; on the other hand, the detection of carbon monoxide was not effective during the hot and flaming stage, but was effective during the smoldering stage. It is, therefore, necessary, for a fireplace spillage advisor to incorporate both technologies. The design and optimum location of a fireplace spillage advisor are discussed. A list of fires due to burning solid fuel in British Columbia during the year of 1985 in given, together with their assumed causes. 6 figs., 2 tabs.

45875 (EGG-M–89123) **NO_x emission characteristics of industrial burners and control methods under oxygen enriched combustion conditions.** Kobayashi, Hisashi; Silver, L.S.; Kwan, Yul; Chen, Shin L. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 19p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-8905204–1: International flame research foundation, 24-26 May 1989). Order Number DE89016358/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Flame characteristics and emissions of NO_x were measured for four different industrial burners in two test furnaces for firing rates between 0.5 and 10 x 10^6 Btu and furnace temperature between 2000 and 2700°F. Both natural gas and No. 6 fuel oil were used. Oxygen concentration of enriched air was varied from 21 to 100%. NO_x emissions with natural gas increased sharply from 0.1 to over 1.85 lb/10^6 Btu at a constant furnace temperature was raised from 2000 to 2700°F the NO_x emissions at 35% O_2 rose about 24%. NO_x emissions diminished with increasing oxygen concentration above 50% O_2 for two oxy-fuel burners due to the rate controlling effect of nitrogen concentration. NO_x emissions of 0.36 to 0.48 lb/10^6 BTU were observed for a high flame temperature oxy-fuel burner at 90 to 100% Btu O_2 and 2000-2700°F furnace temperatures. NO_x concentration as low as 0.01 lb/10^6 Btu was measured for a low flame temperature oxy-fuel burner at 100% O_2 and

2000°F furnace temperature. No_x emissions with No. 6 fuel oil containing 0.54% nitrogen were measured for an air burner and an oxy-fuel burner at 2000°F. Relatively small effect on NO_x emission was observed for the air burner. 12 refs., 11 figs. , 1 tab.

45876 (ICST–434053) **Predictive experience of CCRL tunnel furnace for powdered coal firing.** Lockwood, F.C.; Rizvi, S.M.A. Imperial Coll. of Science and Technology, London (UK). 1983. 63p. (MICROLOG–89-02635). Available from CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.

A prediction procedure has been developed for particulate coal firing of a tunnel furnace. Modifications are incorporated in the particle tracking subcode of this procedure which significantly enhance its computer economy relative to earlier codes. It is concluded that the base case model which has formed the basis of many previous predictions, offers a reasonable simulation of the furnace with a Alberta bituminous coal. However, since individual devolatilization and char burn out models have developed with reference to particular coals, there is a need to explore further the universality of these recommendations. Thus far, it is shown that a useful degree of universality seems to be contained by the best of the present devolatilization and char burn out models. The devolatilization and char burn out phenomena appear to be the critical ones for pulverized coal modelling. They depend on many complex factors and have so far been insufficiently explored. On the whole, the predictions of the one data set considered have been good enough to allow the present predictive tool to be used to explore the performance of the tunnel furnace for operating conditions for which measurements are not currently available. 30 refs., 14 figs., 4 tabs.

45877 (NBNRE–8810, pp. 18) **Fuel handling systems for wood-fired heating plants.** Piercy, J.F. (ADI Ltd.). New Brunswick Dept. of Natural Resources and Energy, Fredericton, NB (Canada). Minerals and Energy Div. 1988. (CONF-8810421–: Wood energy symposium, 25-26 Oct 1988; MICROLOG–89-02885). In *Wood energy symposium. Proceedings.* Available from New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The subject of this paper is the design and performance of wood handling systems in use in institutional heating plants in the Province of New Brunswick; seven plants have been selected for examination. Screw conveyors, drag chain conveyors, Patz conveyors, belt conveyors, scraper bins, chain flail bins and screw stokers are discussed. General requirements for any wood handling equipment are a very rugged construction and accessibility. Weak points in existing plants have been identified and remedial measures are proposed.

45878 Apparatus having inductively coupled coaxial coils for measuring buildup of slag or ash in a furnace. Mathur, M.P.; Ekmann, J.M. To Dept. of Energy, Washington, DC. USA Patent 4,829,246. 9 May 1989. Filed date 20 Feb 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

The buildup of slag or ash on the interior surface of a furnace wall is monitored by disposing two coils to form a transformer which is secured adjacent to the inside surface of the furnace wall. The inductive coupling between the two coils of the transformer is affected by the presence of oxides of iron in the slag or ash which is adjacent to the transformer, and the application of a voltage to one winding produces a voltage at the other winding that is related to the thickness of the slag or ash buildup on the inside surface of the furnace wall. The output of the other winding is an electrical signal which can be used to control an alarm or the like or provide an indication of the thickness of the slag or ash buildup at a remote location.

4230 Marine Engineering

Refer also to citation(s) 44527, 44528

45879 (CMEL–W62-11-88-5-1E) **Ice forces on marine structures. Vol. 1, calculations.** Morrison, T.B.; Marcellus, R.W.; Allyn, N.F.B.; Tseng, J. C.M.E.L. Enterprises Ltd., Spencerville, ON (Canada). 1987. 132p. Available from Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Intended for engineers engaged in designing and building large structures in ice-covered waters, this report provides detailed procedures and equations for predicting ice loads under various conditions and scenarios. Brittle failure of first-year and multi-year ridges and sheets, buckling failure of first-year sheets and floes, and ductile failure of an ice sheet surrounding a structure are included. Guidelines are provided for calculating ice forces on four generic types of marine structures: vertical-sided structures, sloping structures, floating structures, and artificial islands. For each type, and general approach to the work is described followed by an example from Canadian experience. All methods described in the report use analytic or numerical models based on estimated mechanical properties of ice. A detailed discussion and state-of-the-art review of methodologies in current use is provided in the companion volume. 60 refs., 47 figs., 8 tabs.

45880 (CMEL–W62-11-88-5-2E) **Ice forces on marine structures. Volume 2, discussion.** Marcellus, R.W.; Morrison, T. B.; Allyn, N.F.B.; Croasdale, K.R.; Iyer, H.S.; Tseng, J. C.M.E.L. Enterprises Ltd., Spencerville, ON (Canada). [1988]. 436p. (MICROLOG–89-02031). Available from Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A comprehensive state-of-the-art review is provided of the current methodologies in use for estimating the impact of ice forces on various kinds of marine structures: vertical sided or sloping stationary structures, floating structures, and artificial islands. Introductory chapters present ice statistics from selected Canadian marine regions, the failure modes and mechanical properties of ice, and general principles of ice/structure interactions. The methods for calculating ice loads are basically alternative methods for predicting the behavior of ice under different loading conditions; as such, none of the models have been successful in predicting the behavior of ice under all loading conditions. Currently the only reliable method for accurately predicting ice forces on marine structures is to use large-scale empirical data for ice of the same state as that predicted for design. Extrapolation from ice behavioral data at a smaller scale or ice of a different state is generally required. In comparison to current uncertainties, reasonably accurate estimates of upper bound static ice forces can be made, and a design approach using this upper bound force is appropriate for very massive rigid structures and in designing for overall global stability. The periodicity of ice forces also needs to be considered in terms of dynamic amplification of structure deformation, potential liquefaction of soils, and fatigue life. In certain cases, the deflection of the structure can change the ice failure process and therefore change the level and nature of the ice force. 221 refs., 171 figs., 19 tabs.

45881 (CRA–W62-11-88-8-9E) **Measurement of the properties of broken ice zones and ice rubble.** Croasdale, K.R. Croasdale (K.R.) and Associates, Calgary, AB (Canada). 1988. 118p. (MICROLOG–89-02021). Available from Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Broken ice zones and ice rubble areas are very common in the offshore northern environment, for example around offshore structures and in nearshore zones. Improved understanding of the bearing capacity and lateral load transfer of broken ice and rubble could lead to improved efficiencies in, for example, offshore structure design and the use of such ice as drilling pads or protective barriers. A research project was conducted to measure the properties of ice rubble and broken ice, focusing on the refreezing of ice rubble after its formation. A time-dependent settlement test on grounded ice rubble was also performed. Measurements were conducted in the Arctic at a grounded rubble field around an artificial

island in the Beaufort Sea, and in a large outdoor ice basin test facility in Alberta. The measurements were compared with the results from analytical models. Ice basin measurements were in good agreement with these models, in contrast with the field measurements. The latter were less easily performed and the results did not consistently agree with the analytical model for the refreezing of ice rubble. Explanations for the lack of agreement may have been due to such factors as porosity, settlement of rubble, snow cover, local winds, and the approximate nature of rubble porosity measurements. 3 refs., 33 figs., 10 tabs.

45882 (DNV/C–W62-11-88-2E) **Probabilistic framework for ice loads on fixed marine structures. Vol. 2, user's guide to load computer package.** Nessim, M.; Cormeau, A. Det Norske Veritas (Canada) Ltd. (Canada). 1988. 97p. (MICROLOG–89-02022). Available from Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A computer program package has been developed to calculate global and local ice loads on fixed marine structures under Canadian conditions. This document describes the overall features and structure of the package, and provides information on files and file handling, and running the programs. The package is capable of handling vertical sided structures with cylindrical or flat sides (i.e. circular or polygonal in plan), or upward and downward breaking cones (except in landfast zones or in the Grand Banks area, where they are not allowed). A number of ice load scenarios are able to be specified, for both the landfast ice zone and the active ice zone, including different types of partial ice cover, full ice cover, and open water situations. An example run is presented for a circular vertical structure in the pack zone of the Canadian Beaufort Sea, considering scenarios involving first-year ridges, level ice, and multi-year floes in the full ice cover season. 2 figs., 5 tabs.

45883 (DNV/C–W62-11-88-6E) **Development of a model for progressive damage in ice.** Cormeau, A.; Jordan, I.J.; Maes, M. Det Norske Veritas (Canada) Ltd. (Canada). 1988. 127p. (MICROLOG–89-02042). Available from Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This report addresses two important aspects of the interaction between ice and fixed structures: progressive damage to ice during compression, an the clearing of pulverized material around an indentor. Computer models were developed using finite element methods to emulate and analyze the behaviour of ice, including the viscous flow of crushed ice. Scarcity of relevant data on ice crushing led to a number of assumptions based on existing damage theories for metals, concrete and rocks. An isotropic shear degradation model was implemented and uniaxial loading tests were applied, showing strain softening effects. A shear damage model was successfully applied to the spread of microcracks during an ice sheet indentation test. An accurate prediction of the shape of the crushed layer was inhibited by the restrictions associated with the explicit time step algorithm. A relationship among velocity, viscosity, ice thickness and pressure on the indenter was derived. 60 refs., 34 figs., 2 tabs.

45884 (DNV/C–W62-11-88-11-1E) **Probabilistic framework for ice loads on fixed marine structures. Vol. 1, study description.** Nessim, M.; Cormeau, A. Det Norske Veritas (Canada) Ltd. (Canada). 1988. 175p. (MICROLOG–89-02022). Available from Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Probabilistic models have been developed for the estimation of global and local ice interactions with fixed marine structures in Canadian offshore waters. The models produce load descriptions which are compatible with probability-based design code requirements and can thus be used in selecting design criteria. Ice loading is estimated by using probabilistic environmental inputs in appropriate ice-structure interaction models to produce a probabilistic distribution of the load. This is then used in extremal models to calculate the probability distribution of the maximum annual load or pressure which is the basis for selecting design loads. The study included the statistical analysis of environmental data and ice mechanical properties in order to obtain the best probabilistic descriptors of input parameters to the model. Ice-structure interaction models were selected from available approaches and new models were developed for areal ice feature collisions in open water and winter conditions. The probabilistic models which were developed included stochastic process models for differenct ice load scenarios, models for the exposure levels of the structure to a given scenario and models for estimating the load magnitude during stationary continuous processes are also used. These components were included in integrated models and computer programs for calculating global loads and local pressures and techniques for dealing with short data records were also developed. 63 refs., 47 figs., 18 tabs.

45885 (IKU-R–32.0326.00/01/88) **Ionosphere influences on the navigation and positioning with the Navstar Global Positioning System (GPS).** Haarstad, I. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Mar 1988. 92p. (In Norwegian). Order Number DE89914756/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The report concerns a project dealing with the use of the Navstar-GPS (Global Positioning System) in the polar regions of Norway. The quality of data influenced by ionospheric disturbances in connection with the accuracy of navigation and positioning in the area are investigated. The various instruments and methods used in the investigation are presented.

45886 (NEI-DK–190) **Analysis of prototype freak waves.** Klinting, P.; Sand, S.E. Dansk Hydraulisk Inst., Hoersholm (Denmark). 1987. 15p. (CONF-8706402–1: ASCE special conference nearshore hydrodynamics, Jun 1987). Order Number DE89914662/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

EFP-86.

From continuous storm wave records taken in the North Sea freak wave envents have been isolated and analyzed. The analyses have been performed on several levels. First of all it has been investigated whether surface profiles and horizontal orbital velocities could be explained by 2-D (long crested) wave theories up to fifth order. Secondly, the phenomenon has been treated as a 3-D (directional) interaction case. Velocity vectors in three levels have been studied in order to reveal possible special 3-D characteristics. Also low and high-pass filters have been used as elements in the analysis of the composition of freak waves. From the limited amount of data analyzed so far the high frequency part of the freak waves seems to be strongly directional. In order to describe in detail the character of the high frequency waves a three-dimensional second-order (higher harmonic) separation technique was used to isolate bound- and free components. As a reference for future analysis of freak waves the wave climate producing the ones presented herein has also been analyzed in detail. Development with time of mean directions, directional spread and spectral density is presented. (author).

45887 (NEI-NO–90, pp. 8) **Mapping of central depressions.** Dekko, T. Norske Sivilingenioerers Forening, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with the mapping of central sea bed depressions (pock marks) on the Norwegian continental shelf. The mapping is done in the western part of the Norwegian Trench for the selection of a pipeline route from the Oseberg field to the west coast of Norway. Examples from the surveyed depressions done with echosounders, deep towed boomers, side scan sonars, and ROV (Remote Operational Vehicles) are compared. 5 figures.

45888 (RF-SPS-A–44/85) **Working environment and safety in offshore drilling. Remote control/automation of drilling operations.** Mortensen, A. Rogalandsforskning, Stavanger (Norway). Oct 1985. 78p. (In Norwegian). Order Number DE89914786/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The evaluation of methods to be used for the mechanization and automatization of dangerous drilling operations has been an actual theme for a period of five to ten years in Norway. The legislation in this field has enforced the development of mechanized equipment on the drilling floor for new types of drilling rigs. The experience gained from the use of integrated instrumentation and automation in similar projects are discussed. The use of such types of systems and also an advanced operator communication are fundamentals for the design of automatized drilling rigs in the future. Different methods of development for automated drill-pipe handling are considered. New concepts for a derrick are discussed. In the appendix, examples are given on the design of a control room for drillers and a process control and data acquisition system. 34 figs., 1 tab., 5 refs.

4240 Pollution Control Equipment

Refer also to citation(s) 44445, 44514, 44515, 46098

45889 Submersible purification system for radioactive water. Abbot, M.L.; Lewis, D.R. To Dept. of Energy, Washington, DC. USA Patent 4,828,691. 9 May 1989. Filed date 30 Nov 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A portable, submersible water purification system for use in a pool of water containing radioactive contamination includes a prefilter for filtering particulates from the water. A resin bed is then provided for removal of remaining dissolved, particulate, organic, and colloidal impurities from the prefiltered water. A sterilizer then sterilizes the water. The prefilter and resin bed are suitably contained and are submerged in the pool. The sterilizer is water tight and located at the surface of the pool. The water is circulated from the pool through the prefilter, resin bed, and sterilizer by suitable pump or the like. In the preferred embodiment, the resin bed is contained within a tank which stands on the bottom of the pool and to which a base mounting the prefilter and pump is attached. An inlet for the pump is provided adjacent the bottom of the pool, while the sterilizer and outlet for the system is located adjacent the top of the pool.

4250 Power Cycles

Refer also to citation(s) 45325, 45377, 45414

43 PARTICLE ACCELERATORS

Refer also to citation(s) 46508

45890 Introduction to the physics of particle accelerators. Edwards, D.A. (Fermi National Accelerator Lab., Batavia, IL (USA)); Syphers, M.J. pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The purpose of this course is to illustrate the application of the principles of physics in the field of particle accelerators. The emphasis is on the principles rather than the technology. The authors do not attempt to survey the entire field. Rather, they have selected topics that are consistent with their experience and that they think are interesting. Since they have primarily worked with synchrotrons, much of the discussion will relate to this variety of accelerator. The first half of the course deals with the motion of a single particle under the influence of electric and magnetic fields. The basic language of linear and circular accelerators is developed in this material. The principle of phase stability is introduced, and phase oscillations in linacs and synchrotrons are studied. Next, the by-now standard treatment of betatron oscillations is presented, followed by an excursion into nonlinear dynamics and its application to accelerators. A specialist in accelerator dynamics would likely use more sophisticated techniques than is used in much of this discussion. Though they do make use of the Hamiltonian formalism in some of the treatment of non-linear motion, they feel that a more elementary approach is better suited for an introduction to the subject. In the first half of the course the particles are assumed to interact neither with each other nor with their environment. During the second half of the course, these restrictions are removed, and much of the discussion relates to intensity-dependent effects - in particular, space charge, and coherent instabilities. 14 references.

45891 Description of particle accelerators using high-order perturbation theory on maps. Berz, M. (Univ. of Giessen (West Germany)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The perturbative description of particle accelerators using Taylor series maps is discussed. A new technique is presented which allows a very efficient computation of high order maps. It is shown how this method can be used to determine maps of the action of various electromagnetic fields including fringe fields, measured fields and space-charge fields. Once the map of the system is known, it can be used for several purposes. Firstly, it allows an exact, non-numerical calculation of quantities of interest like tune shifts and chromaticities. Secondly, it can be transformed into different coordinates in which the motion of the particles has a particularly simple form and which is helpful for the search of invariants and KAM surfaces. Finally the map can also be used for tracking, if desired also in combination with symplectification procedures. Here the major advantage of the map is the gain in speed compared to direct tracking. As with any tracking method, however, care should be exercised not to overestimate the results of such simulations, in particular for large numbers of iterations. 37 references, 6 figures.

45892 Methods of stability analysis in nonlinear mechanics. Warnock, R.L. (Stanford Univ., CA (USA)); Ruth, R.D.; Gabella, W.; Ecklund, K. pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). DOE Contract FG02-86ER40302. (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The authors review their recent work on methods to study stability in nonlinear mechanics, especially for the problems of particle accelerators, and compare their ideas to those of other authors. They emphasize methods that (a) show promise as practical design tools, (b) are effective when the nonlinearity is large, and (c) have a strong theoretical basis. 24 references, 2 figures, 2 tables.

45893 Review on the lattice design of large hadron colliders. Lee, S.Y. (Brookhaven National Lab., Upton, NY (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The conceptual evolution of the accelerator lattice design is discussed. Indicated are aspects of IR design. The cancellation of stop-band width in the cluster design is emphasized. The case of symmetric vs antisymmetric design is also discussed. The SSC lattice is used as an example. 9 references, 7 figures, 1 table.

45894 Physics of codes. Cooper, R.K. (Los Alamos National Lab., NM (USA)); Jones, M.E. pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The title given this paper is a bit presumptuous, since one can hardly expect to cover the physics incorporated into all the codes already written and currently being written. The authors focus on those codes which have been found to be particularly useful in the analysis and design of linacs. At that the authors will be a bit parochial and discuss primarily those codes used for the design of radio-frequency (rf) linacs, although the discussions of TRANSPORT and MARYLIE have little to do with the time structures of the beams being analyzed. The plan of this paper is first to describe rather simply the concepts of emittance and brightness, then to describe rather briefly each of the codes TRANSPORT, PARMTEQ, TBCI, MARYLIE, and ISIS, indicating what physics is and is not included

in each of them. It is expected that the vast majority of what is covered will apply equally well to protons and electrons (and other particles). This material is intended to be tutorial in nature and can in no way be expected to be exhaustive. 31 references, 4 figures.

45895 Canonical integrators as tracking codes (or how to integrate perturbation theory with tracking). Forest, E. (Lawrence Berkeley Lab., CA (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

This lecture is supposed to be about tracking codes. This lecture is actually about the ideal single-particle code for a large circular machine. This code must be able to track particles and produce high-order maps that can be analyzed by canonical perturbation theory. This lecture will set guidelines for critically judging the existing codes as well as the future codes that might be designed. 15 references.

45896 Science in the age of accelerators. Perl, M.L. (Stanford Linear Accelerator Center, CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00515. (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Accelerators have brought the particle physicists to work and live in three worlds: the private world of science, the public world of science, and the world of large accelerators. The private world is the apparatus, the data, the theories, the colleagues, the journals, the meetings, and above all the understanding of elementary particles. The public world of science is how society sees scientists and how scientist want to be seen in newspapers and on TV, how scientist interact with governments, and most important how governments support science. 7 references, 20 figures.

45897 Accelerator projects, worldwide. Teng, L.C. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

At any given time one always has the feeling that the funding for basic research is tight and inadequate. But an overall examination of the current accelerator projects in the world at all stages of proposal, construction, and operation proves to be rather reassuring. The result of this survey is presented here in tabulated form, and the rationale and utility of these projects are discussed and compared. Accelerator projects can be broadly classified in the following four categories: (1) High Energy Colliders - The pursuit of high energies or small dimensions for particle physics studies is the initial and basic motivation for the development of accelerators. The high energy frontier is now covered exclusively by colliders. (2) High Intensity, Medium Energy Accelerators - Machines of this category are useful for both particle and nuclear physics research. (3) Synchrotron Radiation Storage Rings - These machines have mushroomed during the past decade into a large and important category of accelerators. The synchrotron radiation from an electron beam travelling inside the dipole magnets or the undulators in a storage ring yields VUV and X-rays of unprecedented brilliance and brightness for studies of atoms, molecules, and condensed matters, and for industrial and medical applications. Most of these storage rings are in the energy range of 0.7 GeV to 7 GeV. (4) Low Energy Medical, Industrial and Research Accelerators - Large numbers of low energy accelerators of all types are used for atomic and nuclear research and for applications in industry and medicine. This paper describes principally projects of the first two categories. 1 figure, 5 tables.

45898 (SAND--89-7066) **Aurora second single arm tests.** Warren, T. Physics International Co., San Leandro, CA (USA). Mar 1989. 56p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (PIFR--4032). Order Number DE89015195/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Aurora Prompt Gamma Flash Simulator is a four module, 14-TW pulsed power machine that has been operated by Harry Diamond Laboratories (HDL) since it was commissioned in 1972. In response to new simulation needs, Aurora has been undergoing a series of machine upgrades aimed at providing a more flexible simulation environment. These upgrades have included developing multi-pulse and short-pulse capabilities, and improving machine reliability with new Marx generators. One outgrowth of the new machine capabilities is the requirement for improved synchronization of the four Blumlein modules. This improved synchronization has been the subject of a joint program between Physics International (PI) and Sandia National Laboratories in Albuquerque (SNLA) funded by Harry Diamond Laboratories. 9 refs., 19 figs., 7 tabs.

4301 Design, Development, and Operation

Refer also to citation(s) 46429

45899 (ANL--87-15) **7-GeV Advanced Photon Source Conceptual Design Report.** Argonne National Lab., IL (USA). Apr 1987. 515p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE89015624/JAW. Available from NTIS, PC A22/MF A01; OSTI; INIS; GPO Dep.

During the past decade, synchrotron radiation emitted by circulating electron beams has come into wide use as a powerful, versatile source of x-rays for probing the structure of matter and for studying various physical processes. Several synchrotron radiation facilities with different designs and characteristics are now in regular operation throughout the world, with recent additions in this country being the 0.8-GeV and 2.5-GeV rings of NSLS at Brookhaven National Laboratory. However, none of the operating facilities has been designed to use a low-emittance, high-energy stored beam, together with modern undulator devices, to produce a large number of hard x-ray beams of extremely high brilliance. This document is a proposal to the Department of Energy to construct and operate high-energy synchrotron radiation facility at Argonne National Laboratory. We have now chosen to set the design energy of this facility at 7.0 GeV, with the capability to operate at up to 7.5 GeV.

45900 (ANL--87-15-Annex) **Annex to 7-GeV Advanced Photon Source Conceptual Design Report.** Argonne National Lab., IL (USA). May 1988. 172p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. Order Number DE89015625/JAW. Available from NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

The Annex to the 7-GeV Advanced Photon Source Conceptual Design Report updates the Conceptual Design Report of 1987 (CDR-87) to include the results of further optimization and changes of the design during the past year. The design changes can be summarized as affecting three areas: the accelerator system, conventional facilities, and experimental systems. Most of the changes in the accelerator system result from inclusion of a positron accumulator ring (PAR), which was added at the suggestion of the 1987 DOE Review Committee, to speed up the filling rate of the storage ring. The addition of the PAR necessitates many minor changes in the linac system, the injector synchrotron, and the low-energy beam transport lines. 63 figs., 18 tabs.

45901 (BNL--52205) **Phase 2 safety analysis report: National Synchrotron Light Source.** Stefan, P. (ed.). Brookhaven National Lab., Upton, NY (USA). Jun 1989. 131p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89015179/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Phase II program was established in order to provide additional space for experiments, and also staging and equipment storage areas. It also provides additional office space and new types of advanced instrumentation for users. This document will deal with the new safety issues resulting from this extensive expansion program, and should be used as a supplement to BNL Report No. 51584 "National Synchrotron Light Source Safety Analysis Report," July 1982 (hereafter referred to as the Phase I SAR). The initial NSLS facility is described in the Phase I SAR. It comprises two electron storage rings, an injection system common to both, experimental beam lines and equipment, and office and support areas, all of which are housed in a 74,000 sq. ft. building. The X-ray Ring

provides for 28 primary beam ports and the VUV Ring, 16. Each port is capable of division into 2 or 3 separate beam lines. All ports receive their synchrotron light from conventional bending magnet sources, the magnets being part of the storage ring lattice. 4 refs.

45902 Compendium of computer codes used in particle accelerator design and analysis. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.). American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

In preparing this compilation, the authors came across the names of more than 150 programs that have been used in the design and analysis of accelerators. Many are obsolete and some are not easily transported from the institution where they were created. All are included in this compilation and filed at Los Alamos, but the obsolete codes have been removed from this article. Other than the judgment as to whether or not a particular code is obsolete, any critical evaluations have not been made. This document is organized so that each code is described on a one- or two-page data sheet. The data sheets are arranged alphabetically by code name but are not numbered. In this way, it will be easy to insert new codes as they are discovered. The code data sheets are preceded by three indexes: (1) subject, (2) person-to-contact, and (3) code acronym. It was not useful to list codes by authors because, in many cases, the original author is no longer associated with the code and many other persons have contributed to maintaining and improving the code.

45903 Final focus systems for linear colliders. Erickson, R.A. (Stanford Linear Accelerator Center, CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00515. (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The final focus system of a linear collider must perform two primary functions: it must focus the two opposing beams so that their transverse dimensions at the interaction point are small enough to yield acceptable luminosity, and it must steer the beams together to maintain collisions. In addition, the final focus system must transport the outgoing disrupted beams to a location where they can be recycled or safely dumped. As of this writing, the only full-scale collider final focusing system actually constructed is that of the SLAC Linear Collider, better known simply as the SLC. The SLC is not a true linear collider in the sense of having two linacs pointed at each other. Instead, a single linac is used to accelerate bunches of positrons and electrons simultaneously to the desired energy. The bunches are then separated and guided around two arcs of alternating-gradient bending magnets to opposite ends of the final focus system. At the time of this writing, the construction of the SLC has been essentially completed, and initial commissioning tests are in progress. While most of the examples in this paper are drawn from the SLC, the principles and conclusions are generally applicable to other linear collider designs as well. 26 references, 17 figures, 1 table.

45904 Application of pulse power technology to ultra high energy electron accelerators. Nation, J.A. (Cornell Univ., Ithaca, NY (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The author presents in this paper a review of the application of pulse power technology to the development of high gradient electron accelerators. The technology demands are relatively modest compared to the ultra high power technology used for inertial confinement fusion drivers. With the advent of magnetic switching intense electron beams can be generated with a sufficiently high repetition rate to be of interest for high energy electron accelerator driver applications. Most of the techniques considered rely on the excitation of large amplitude waves on the beams. Within this framework there are two broad categories of accelerator, those in which the waves are directly excited in and supported by the medium and, secondly, those where the waves are used to generate radiofrequency signals which are then coupled via structures to the beam being accelerated. In what follows we shall consider both approaches. Present-day pulse power technology limits pulse durations to about 100 nsec. Consequently, if these sources are to be used, we will need to use high group velocity structures to avoid the need for short accelerator module lengths. An advantage of the short pulse duration is that the available acceleration voltage gradient increases compared to that obtained using conventional rf drivers. 19 references, 9 figures, 1 table.

45905 Plasma acceleration of particle beams. Katsouleas, T. (Univ. of California, Los Angeles (USA)); Dawson, J.M. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Plasmas, being fully ionized gases, are immune from electrical breakdown and so can support ultra-high accelerating fields (order GeV/cm) in the form of relativistic plasma waves. Several schemes to excite these waves and use them for particle acceleration are reviewed in this article. These include the beat wave accelerator (laser driven) and the plasma wavefield transformer (particle beam driven). In addition, the possible use of plasmas to provide strong final focusing of beams (the plasma lens) is described. 39 references, 21 figures.

45906 Introduction. Edwards, D.A. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The Tevatron project included the construction of three new synchrotrons, but common usage has attached that name to the superconducting ring. In the mid 70's the growing appreciation of the potential of hadron colliders added an additional function to the requirements for the superconducting ring. It should act as a storage ring as well. The main special design features of the superconducting accelerator are the magnets themselves and the cryogenics to cool them. But other systems are also required such as magnet power systems and vacuum systems. The Tevatron was commissioned in 1983. Over four years after its commissioning, the Tevatron is still very much a prototype accelerator, as much a research instrument in its own right as it is a high energy physics tool.

45907 Emittance through the Fermilab accelerator chain. Finley, D. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

In this chapter the development of the proton beam emittance through the Fermilab accelerator chain from the 750-keV preaccelerator to the Tevatron is discussed. The basic relationships used to describe emittances are contained in Appendix A of Teng's paper in this volume, and the student may wish to refer to it at this time. The measurements given here were taken during late 1984 and early 1986. They indicated where there were some sources of emittance increase. Since that time, some improvements have been made and others are planned. 9 figures, 2 tables.

45908 Longitudinal phase space in circular accelerators. Martin, P.S. (Fermi National Accelerator Laboratory, Batavia, IL (USA)); Ohnuma, S. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Here the author presents the formulae used to calculate bunch and bucket parameters for beams in circular accelerators. Then using these formulae, he analyzes one of the rf manipulations used for the Tevatron I collider operation and proposed for use in the SSC injector. 4 references, 17 figures, 3 tables.

45909 Longitudinal instabilities and stability criteria. Ng, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

First the author discusses the criteria necessary for longitudinal microwave instability. The second section estimates the limits of $Z_{\parallel}$ impedance, for the Main Ring in order to ensure longitudinal instability during its different performances. Section three addresses the estimates for impedance of the Main Ring at both low and high frequencies. Section four and five discuss experiments to measure impedance. 16 references, 21 figures, 8 tables.

45910 Beam loss. VanGinneken, A. (Fermi National Accelerator Lab., Batavia, IL (USA)); Edwards, D.; Harrison, M. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

A basic problem in the operation of a superconducting accelerator is that of beam loss. Appreciable levels of energy deposition in the superconducting magnet coils result from relatively small fractions of the total circulating beam impinging on the magnets. This energy can heat the superconducting coil above transition temperature, causing it to go normal and the element to quench. The results deposition of internally stored magnetic energy causes a rapid temperature rise. Recovery from a magnet quench varies from about 20 minutes to several hours and is thus very disruptive to the accelerator operation. In the initial stages of the Tevatron project concerns arose regarding the ability of the superconducting magnets to function in an operational environment where significant beam losses are present. Energy deposition experiments were performed in the Fermilab external beam areas, which then provided the impetus for developing the necessary computer codes. This paper describes the accelerator geometry. The rest of the paper discusses a detailed attempt to simulate a fast extraction cycle, essentially in chronological order. These interact either elastically or inelastically with the septum wires, and the products of these interactions are traced through the machine. Where these particles leave the accelerator, energy deposition levels in the magnets are calculated together with the projected response of the beam-loss monitors in this region. Finally, results of the calculation are compared with experimental data. 16 references, 26 figures, 2 tables.

45911 Induction accelerators and free-electron lasers at LLNL. Briggs, R.J. (Lawrence Livermore National Lab., CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). DOE Contract W-7405-ENG-48. (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Linear induction accelerators have been developed to produce pulses of charged particles at voltages exceeding the capabilities of single-stage, diode-type accelerators and at currents too high for rf accelerators. In principle, one can accelerate charged particles to arbitrarily high voltages using a multi-stage induction machine. The advent of magnetic pulse power systems makes sustained operation at high repetition rates practical, and high-average-power capability is very likely to open up many new applications of induction machines. In part A of this paper, the US induction linac technology is surveyed emphasizing electron machines. A simplified description is given of how induction machines couple energy to the electron beam to illustrate many general issues that designers of high-brightness and high-average-power induction linacs must consider. An example is given of the application of induction accelerator technology to the relativistic klystron, a power source for high-gradient accelerators. In part B the application of LIAs to free-electron lasers is addressed. The multikiloampere peak currents available from linear induction accelerators make high-gain, free-electron laser amplifier configurations feasible. High extraction efficiencies in a single pass of the electron beam are possible if the wiggler parameters are appropriately tapered, as recently demonstrated at millimeter wavelengths on the 4-MeV ELF facility. Key issues involved in extending the technology to shorter wavelengths and higher average powers are described. Current FEL experiments at LLNL are discussed. 5 references, 16 figures, 1 table.

45912 Particle accelerators and discoveries in elementary particle physics. Jones, L.W. (Univ. of Michigan, Ann Arbor (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Some discoveries in elementary particle physics are recounted from personal and historical perspective with particular reference to their interaction with particle accelerators. The particular examples chosen include the ψ/J, the Y, and the study of nucleon constituents with inelastic electron scattering. Precursor experiments are cited together with the better known discoveries. 27 references, 9 figures, 1 table.

45913 (IN2-P3--89-01, pp. 213-254) **TeV linear e+e- colliders.** Le Duff, J. (Paris-11 Univ., 91 - Orsay (FR). Lab. de l'Accelerateur Lineaire). Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. (In French). (CONF-8709294--: 19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics), 7-11 Sep 1987). In *Strings and superstrings. Electron linear colliders.* Order Number DE89903207/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The limits of circular e^+e^- colliders and the principles of linear colliders are presented. Constraints linked to performance: luminosity and beam-beam Bremsstrahlung are indicated. Technical constraints are reviewed: accelerating structures, output, and efficiency; HF breakdown; superconducting structures; HF power sources (klystrons, lasertrons); electron guns; and storage rings.

45914 (IN2-P3--89-01, pp. 255-283) **Recent progress at the Stanford linear collider.** Bambade, P.S. (Stanford linear accelerator center, Menlo Park, CA (US)). Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. (CONF-8709294--: 19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics), 7-11 Sep 1987). In *Strings and superstrings. Electron linear colliders.* Order Number DE89903207/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Commissioning of the Stanford linear collider is proceeding towards an initial low luminosity physics run. Both beams are routinely extracted onto their dumps, and reasonably small beam sizes are produced at the IP. Main priorities are phase-space controls and stability in the whole machine needed to maintain small spots, background reductions, and general system reliability. Studies indicate that collimators may have to be redeployed in the final focus to upstream places where beams can be comfortably trimmed without generating excessive muons in the detector. Enhanced optical matching in the arcs through harmonic corrections is being considered to help reduce distortions in the final focus. It is hoped to produce and detect a hundred Z^0.

45915 (KEK--88-10, pp. 330-339) **Research and development for the Japanese linear collider JLC.** Takata, Koji (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324--: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

Conceptual design work was started in 1984 for a 1 TeV linear collider in Japan and since then, R and D activities have been continued to extend the technology. In the present report, the results are summarized and prospects for the coming two to three years are given. The present plan for continuing the lasertron experiment is to try large voltages beyond 150kV to confirm the principle of operation and also to develop strong photocathodes made of, for example, Cs_3Sb or Cs_3Sb-K. The debunching effect would be far severer when the frequency is raised four times the present one to the design value 11.4 GHz. The lasertron thus needs much R and

D before it becomes of practical use as a high power microwave source. But the photocathode technology developed so far would be applied for a high current electron source of an extremely low emittance and also polarized electron source. The second subject has been to try to excite in accelerating structure a high gradient field on the order of 100 MV/m which is far beyond the level attained for linear accelerators in Japan. While all experiments of this kind outside Japan have been aimed at exciting a standing wave mode in a structure, the aim of the present project is to excite a travelling wave mode which is employed in actual linear accelerators. (N.K.).

45916 (LBL–27496) **A history of central collisions at the Bevalac.** Poskanzer, A.M. Lawrence Berkeley Lab., CA (USA). Jul 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8905143–10: NATO international advanced courses on the nuclear equation of state, 12 May - 3 jun 1989). Order Number DE89016046/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

You have heard a great deal about Plastic Ball results at this conference. There were talks on the first morning by Hans-Georg Ritter and Karl-Heinz Kampert on the Plastic Ball at Berkeley, there will be a talk next week by Rudi Schmidt on the Plastic Ball at CERN, and many other speakers have mentioned Plastic Ball results. The young students may think that when the new field of relativistic heavy ion physics opened up, an ideal detector was designed and built, data immediately analyzed, and results produced. The theme of my talk is to show that this is incorrect. The experiments proceeded in logical stages, one building upon the other, increasing in complexity and sophistication. The analysis techniques and the theory developed along with the experiments. If the more senior people in the audience easily remember this history of the development of the relativistic heavy ion field, they may spend their time during this talk thinking about what is happening now and what will happen in the future in the ultrarelativistic heavy ion field, where I believe history is repeating itself. 18 refs., 18 figs.

45917 (SLAC-PUB–5024) **Alignment and vibration issues in TeV linear collider design.** Fischer, G.E. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–4: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89015631/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The next generation of linear colliders will require alignment accuracies and stabilities of component placement at least one, perhaps two, orders of magnitude better than can be achieved by the conventional methods and procedures in practice today. The magnitudes of these component-placement tolerances for current designs of various linear collider subsystems are tabulated. In the micron range, long-term ground motion is sufficiently rapid that on-line reference and mechanical correction systems are called for. Some recent experiences with the upgraded SLAC laser alignment systems and examples of some conceivable solutions for the future are described. The so called "girder" problem is discussed in the light of ambient and vibratory disturbances. The importance of the quality of the underlying geology is stressed. The necessity and limitations of public-beam-derived placement information are mentioned. 40 refs., 4 figs., 1 tab.

4302 Beam Dynamics, Field Calculations, and Ion Optics

Refer also to citation(s) 45784, 45955, 45963, 45965, 45970, 45972, 46677

45918 (ANL-HEP-CP–89-75) **Experimental studies of plasma wake-field acceleration and focusing.** Rosenzweig, J.B.; Cole, B.; Ho, C.; Gai, W.; Konecny, R.; Mtingwa, S.; Norem, J.; Rosing, M.; Schoessow, P.; Simpson, J. Argonne National Lab., IL (USA). High Energy Physics Div. 18 Jul 1989. 49p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. (CONF-8905156–2: International Centre for Theoretical Physics conference, 22-26 May 1989). Order Number DE89016718/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

More than four years after the initial proposal of the Plasma Wake-field Accelerator (PWFA), it continues to be the object of much investigation, due to the promise of the ultra-high accelerating gradients that can exist in relativistic plasma waves driven in the wake of charged particle beams. These large amplitude plasma wake-fields are of interest in the laboratory, both for the wealth of basic nonlinear plasma wave phenomena which can be studied, as well as for the applications of acceleration of focusing of electrons and positrons in future linear colliders. Plasma wake-field waves are also of importance in nature, due to their possible role in direct cosmic ray acceleration. The purpose of the present work is to review the recent experimental advances made in PWFA research at Argonne National Laboratory, in which many interesting beam and plasma phenomena have been observed. Emphasis is given to discussion of the nonlinear aspects of the PWFA beam-plasma interaction. 29 refs., 13 figs.

45919 **Transverse motion of single particles in accelerators.** Talman, R. (Cornell Univ., Ithaca, NY (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Any accelerator must have focusing elements, usually magnetic quadrupoles, which hold individual particles close to an ideal central orbit. The purpose of this chapter is to analyze the transverse motion of particles and beams in such systems, with particular emphasis on circular machines. A particle not precisely on the central orbit is subject to a restoring force tending to reduce the deviation and, as a result, the particle oscillates around the central orbit. These oscillations are usually called betatron oscillations when they occur in a circular machine, and the same terminology will be used even for motion in any beam transport system. There is a well established formalism for the mathematical description of betatron motion. For want of a better name and following Collins this could be called Beta Theory, since the main function appearing in the theory is $\beta(s)$, where s is a longitudinal coordinate measuring arc length along the central orbit. 10 references, 11 figures.

45920 **Fundamentals - longitudinal motion.** Weng, W.T. (Brookhaven National Lab., Upton, NY (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

There are many ways to accelerate charged particles to high energy for physics research. Each has served its purpose but eventually has encountered fundamental limitations of one kind or another. Looking at the famous Livingston curve, the initial birth and final level-off of all types of accelerators is seen. In fact, in the mid-80s we personally witnessed the creation of a new type of collider - the Stanford Linear Collider. Also witnessed, was the resurgence of study into novel methods of acceleration. This paper will cover acceleration and longitudinal motion in a synchrotron. A synchrotron is a circular accelerator with the following three characteristics: (1) Magnetic guiding (dipole) and confinement (quadrupole) components are placed in a small neighborhood around the equilibrium orbit. (2) Particles are kept in resonance with the radio-frequency electric field indefinitely to achieve acceleration to higher energies. (3) Magnetic fields are varied adiabatically with the energy of the particle. D. Edwards described the transverse oscillations of particles in a synchrotron. Here the author talks about the longitudinal oscillations of particles. The phase stability principle was invented by V. Veksler and E. McMillan independently in 1945. The phase stability and strong focusing principle, invented by Courant and Livingston in 1952, enabled the steady energy gain of accelerators and storage rings witnessed during the past 30 years. This paper is a unified overview of the related rf subjects in an accelerator and a close coupling between accelerator physics and engineering practices, which is essential for the major progress in areas such as high intensity synchrotrons, a multistage accelerator complex, and anti-proton production and cooling, made possible in the past 20 years.

45921 Beam observation and the nature of instabilities. Gareyte, J. (CERN, Geneva (Switzerland)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The point of view presented in this paper will be that of an experimental accelerator physicist who had to struggle for many years with all sorts of collective beam instabilities occurring in different accelerators and storage rings and this, most often, with great enjoyment. Detailed and rigorous mathematical descriptions, as well as quantitative formulae to evaluate thresholds and growth rates will be found elsewhere. Here the author will dwell on the various means which have been invented to observe the beams, to track and record their most intimate behavior in order to assess their margin of stability, and finally through a better understanding of their properties to devise ways of increasing the machine performance. Although in this exercise good theories are a necessary ingredient, more emphasis will be put on the almost intuitive understanding of the nature of the fundamental phenomena at work. The first chapter will describe the observable manifestations of an ensemble of particles with no interactions between them. The second and third chapters will study the effect of wake fields on the collective behavior of the beam particles. The basic nature of beam instabilities will be shown with the help of simple examples. 49 references, 39 figures.

45922 Introduction to wakefields and wake potentials. Wilson, P.B. (Stanford Linear Accelerator Center, CA (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00515. (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

What are wakefields and wake potentials, and why are these concepts useful in the physics of linear accelerators and storage rings? This question is approached by first reviewing the basic physical concepts which underlie the mathematical formalism. Then a summary is presented of the various techniques that have been developed to make detailed calculations of wake potentials. Finally, some applications are given to current problems of interest in accelerator physics. No attempt at completeness can be made in an introductory article of modest length. Rather a broad overview is given and key references for more detailed study are listed. It will also be apparent that the last chapter on this subject, with all the loose end neatly tied up, has yet to be written. There are subtle points, there are controversial questions, and active calculations to resolve these questions are continuing at the time of this writing. 61 references, 10 figures, 1 table.

45923 Quantum treatment of beamstrahlung and its application to ribbon pulses. Blankenbecler, R. (Stanford Linear Accelerator Center, CA (USA)); Drell, S.D. pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

In Part I a straightforward high energy expansion is discussed and applied to the problem of radiation from an extended target. In particular, bremsstrahlung from an electron-pulse collision is discussed. A full quantum treatment of the power spectrum and the average energy loss is given. Scaling laws that smoothly join the quantum regime to the classical limit are derived. In Part II the high energy expansion introduced in Part I is used to describe the problem of beamstrahlung due to an extended pulse with an elliptical cross section of arbitrary eccentricity. It is shown that the transverse geometry of the pulse enters in a remarkably simple scaling manner. This case is of interest because the radiative energy loss can be markedly reduced while simultaneously keeping a fixed luminosity if the beam pulses are very thin in one transverse direction, i.e. shaped like ribbons. Effects of other types of beam shaping are briefly discussed, and the physics of the process is emphasized. 30 references, 3 figures, 2 tables.

45924 Methods of beam optics. Willeke, F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)); Ripken, G. pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

In the following report a survey of linear machine theory is given. The investigations are restricted to coasting-beam betatron motion but coupling is taken into account in a general way. The equations of motion for on- and off-momentum particles are derived and written in canonical form. From the canonicity it follows that all transfer matrices are automatically symplectic. Eigenvector methods are introduced to study the stability behavior. To investigate the influence of coupling, generalized lattice functions are defined and canonical perturbation techniques are applied. 13 references, 10 figures.

45925 Nonlinear dynamics. Guignard, G. (CERN, Geneva (Switzerland)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Following an introduction on analytical mechanics, canonical transformations, and perturbation theory, a description is given of nonlinear effects for near-integrable systems associated with resonances, amplitude variations with multiple crossings, adiabatic changes of the parameters, and time variation of the perturbation. Examples of applications coming from observations and calculations related to CERN accelerators concern coupling measurements, intra-beam scattering, beam-beam effects, magnetic imperfections, two-beam overlap knock-out, and synchro-betatron resonances. Finally, the notion of invariant distortion and aperture of bounded motion in the presence of multipoles are introduced. 20 references, 12 figures, 7 tables.

45926 Phase space concepts. Michelotti, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

By 1892, Henri Poincare already had published his landmark work in which he advanced the theses that differential equations should be viewed as geometric objects, in particular, as vector fields on manifolds, and that questions concerning the long-term stability of a dynamical system might be attacked by studying the topological properties of these objects. His work even led him to recognize the extraordinarily complicated behavior of orbits in the vicinity of a separatrix, what today they would call chaos. In these lectures the author looks into this geometric approach to the study of Hamiltonian dynamical systems, especially in connection with the kinds of problems which arises in accelerator orbit theory. The modest goals here will be to delineate the idea of invariant tori in phase space, to define and illustrate the importance of resonant orbits and their separatrices as structures for organizing dynamics, and to touch upon the meaning of chaotic orbits in nonintegrable systems. Further, the author hopes to lessen the impression which some may have acquired during their formal education that classical mechanics is a dull, closed subject with no mysteries left to explore. 26 references, 15 figures.

45927 Comments on nonlinear dynamics studies in storage rings. Chao, A.W. (Lawrence Berkeley Lab., CA (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

If the storage ring optics is perfectly linear, the trajectory of a particle, as observed at a fixed location in the storage ring, traces out a circle in the normalized phase space (q,p). The tune v (phase advance per turn/2π) is independent of the initial coordinates of the particle. It is assumed that v is an irrational number. The picture becomes complicated when a nonlinear perturbation is added to the system. The first complication is the introduction of tune shift. For

particles near the phase-space origin, the tune remains v, but as the particle amplitude A increases, the tune shifts. As the tune changes, it can no longer stay irrational. Around each discrete dot corresponding to a rational tune, an island of finite area is created, and immediately outside the islands is a thin chaotic layer in which the turn-by-turn trajectory does not follow a smooth pattern. As the islands acquire finite sizes, they break the neighboring circles. The islands and chaotic layers emerge spontaneously in the entire phase space, even close to the origin. This means islands near the origin are extremely thin, and most invariant surfaces are able to maintain their existence and suffer only from a small distortion from a circle. The distorted circles constitute invariant surfaces. The percentage distortion from circles is called the smear. As the amplitude increases, the islands grow in size, breaking more invariant surfaces. As amplitude increases further, even the persistent invariant surfaces are broken by neighboring island chains which are now large enough to overlap. The islands still exist, but they now become disjoint, and they are embedded in a chaotic ocean. Particle motion is no longer bounded and instability occurs. The last invariant surface is called the dynamic aperture. 27 references, 7 figures.

45928 **Primer on beam dynamics in synchrotrons.** Teng, L. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

First, the author discusses the factors controlling the beam dynamics when the beam intensity, hence the self-field generated by the beam, is negligible. In this case the motions of the particles in the beam are independent and they have the so-called single-particle dynamics. The single-particle dynamics is clearly controlled only by external electromagnetic fields and external physical barriers such as beam collimators and vacuum chamber walls. The transverse motion is controlled principally by the magnetic field, and the longitudinal motion is controlled by the radiofrequency electric field. Next he discusses intensity-dependent dynamics. 1 table.

45929 **Detection and compensation of transverse resonances.** Gerig, R. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

This chapter discusses the operational implications of the problem of nonlinear dynamics in synchrotrons. Although accelerator designers try to avoid these problems in the design of their machines it is impossible to avoid the problems completely, and as a result it is important to be able to diagnose and provide compensation for the resulting transverse resonances. The author draws from his experience in working with the original 400-GeV Fermilab Main Ring, where these effects have been routinely observed at the injection energy of 8 GeV. The article first presents the problem and how it relates to machine performance. Techniques for measuring and compensating the resonance lines are then discussed, and the design of the correction system used to provide compensation is described. The last section discusses efforts to simulate the measurement and compensation process using a tracking program. 6 references, 5 figures, 2 tables.

45930 (DOE/ER/10666–1) **Analysis of coaxial wire measurement of longitudinal coupling impedance.** Gluckstern, R.L.; Li, R. Maryland Univ., College Park, MD (USA). Dept. of Physics. 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-80ER10666. (CONF-890803–7: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89015748/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In recent work, a method has been developed to calculate the longitudinal impedance for an azimuthally symmetric obstacle in a beam pipe of circular cross section. The method has been applied to a small obstacle, to an obstacle of general shape at high frequency, and to several obstacles, including a periodic structure at high frequency. Coupling impedances are difficult to measure directly. Instead, the reflection and transmission coefficients for a pulse carried through the obstacle on a thin coaxial wire are measured and the results approximate the longitudinal coupling impedance. In the present paper, an analysis is carried out including the coaxial wire and new boundary conditions for the fields at the surface of the wire. We then estimate the validity of the coaxial wire measurement for a variety of frequencies and geometries. Finally, several numerical calculations are carried out for both the beam and the wire pulse. The results confirm the predictions of the analysis. 7 refs., 3 figs.

45931 (FNAL-TM–1608) **Improved bunch spreader modules.** Ieiri, Takao. Fermi National Accelerator Lab., Batavia, IL (USA). 20 Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89015588/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In order to raise the threshold beam current of instabilities in the fixed target run, it is required to increase the longitudinal emittance, and hence the bunch length. The bunch spreader used a noise generator through a sharp-cut ban pass filter (BPF) instead of a coherent signal. In that filter, the pass band frequency was near twice the synchrotron frequency $2f_s$. The bandwidth of the filter was fixed between 350Hz and 600Hz, though twice the synchrotron frequency changed from 500Hz to 300Hz after transition in Main Ring. The noise through the filter is applied to an RF amplitude modulator. In the Tevatron, where the synchrotron frequency f_s varies from 120Hz to 40Hz during acceleration, the noise is applied to a phase shifter at the frequency of f_s. So, we need a tunable filter which tracks $2f_s$ in the Main Ring and f_s in the Tevatron. This note describes details of improved bunch spreader modules using a tunable filter used in both the Main Ring and the Tevatron. A brief description about this module along with a beam test done in the Main Ring is shown. 3 refs., 6 figs.

45932 (GSI–89-09) **KOBRA 3 - a code for the calculation of space-charge-influenced trajectories in 3-dimensions.** Spaedtke, P.; Wipf, S. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Jun 1989. 81p. Order Number DE89915121/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

KOBRA3 is a three-dimensional multi-purpose program, written in standard FORTRAN77. The main purpose of the program is to calculate the trajectories of charged particles through a static electro-magnetic field in three dimensions. If space charge is not negligible its influence is taken into account by an iterative process. The Laplace equation is solved for the scalar potential. During the ray tracing, in which the equations of motion for charged particles are solved, the space charge term in the Poisson equation is distributed onto the mesh. By repeating this procedure the steady-state Vlasov equation is solved: $\text{nabla}^2\text{phi} + \int\int\int f_p dxdydz = 0$, where phi is the electro-static potential and f_p(r vector, v vector) describes the distribution of the charged particles in space. KOBRA3 can handle finite plasma boundaries, which are found by the program automatically. Special features are included within the program to investigate the beam quality (emittance, transverse energy), and to display the geometry, the trajectories and the potential and magnetic fields graphically. The modular structure of the program enables the user to create his (her) own diagnostic programs or interfaces to the main program. This report is intended to facilitate the use of KOBRA3 by describing the theory, structure and numerical methods used. At GSI (Gesellschaft fuer Schwerionenforschung) the program runs on an IBM 3090-40E. The program has been installed on other machines e.g. CRAY XM-P, CRAY II, VAX 8600, IBM 3090-200, IBM 3033, ATARI ST, IBM-AT. (orig./HSI).

45933 (LA-UR–89-2795) **A solution to nonlinearity problems.** Neuffer, D.V. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890803–5: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89016975/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

New methods of correcting dynamic nonlinearities resulting from the multipole content of a synchrotron or transport line are presented. In a simplest form, correction elements are places at the

center (C) of the accelerator half-cells as well as near the focusing (F) and defocusing (D) quadrupoles. In a first approximation, the corrector strengths follow Simpson's Rule, forming an accurate quasi-local canceling approximation to the nonlinearity. The F, C, and D correctors may also be used to obtain precise control of the horizontal, coupled, and vertical motion. Correction by three or more orders of magnitude can be obtained, and simple solutions to a fundamental problem in beam transport have been obtained. 13 refs., 1 fig., 1 tab.

45934 (ORNL/FTR–2990) **[International conference on the physics of electronic and atomic collisions]: Foreign trip report, June 28, 1988–July 29, 1988.** Datz, S. Oak Ridge National Lab., TN (USA). 17 Aug 1988. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017279/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler participated in the Executive Committee and Program Committee meetings of the International Conference on the Physics of Electronic and Atomic Collisions (ICPEAC), held in Paris, France, June 30–July 2, 1988. There he acted as chairman of the task group on long-range planning for ICPEAC, and presented a report on future directions for the conference. He visited the Max Planck Institute for Nuclear Physics in Heidelberg, West Germany, July 5–7, 1988, where discussions were held on possibilities of transferring their cooling technology to Oak Ridge National Laboratory (ORNL) for the forthcoming HISTRDAP project and AIRM Electron Beam Target for the Holifield Heavy Ion Research Facility. The traveler visited the Physics Institute at the University of Giessen, Giessen, West Germany, where discussions were carried out on recent experiments in heavy-ion collision physics, and, in particular, to discuss possible ORNL experiments on electron pair ejection following dielectronic recombination. The traveler then visited the University of Aarhus, Aarhus, Denmark, where a collaborative experiment was performed using their newly operative merged beam electron target (MBET) to study dielectronic recombination in high resolution.

45935 (SLAC-PUB–4920) **An automated focal point positioning and emittance measurement procedure for the interaction point of the SLC.** Phinney, N.; Bambade, P.; Kozanecki, W.; Koska, W. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890335–250: 13. particle accelerator conference, 20-23 Mar 1989). Order Number DE89015629/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

To achieve maximum luminosity at the SLC, both the electron and positron beams must reach their minimum transverse size within 1 mm of the longitudinal location where the two bunches collide. This paper describes an automated procedure for positioning the focal point of each beam at this collision plant. The technique is based on measurements of the beam size utilizing either secondary emission or bremsstrahlung signals from carbon fibers a few microns in diameter. We have achieved simultaneous and reproducible measurements of the angular speed (~200 μrad) and the optimum beam spot size (~2 μm), which when combined yield measurements of the beam emittance consistent with those obtained using conventional profile monitor techniques. 8 refs., 5 figs., 1 tab.

45936 (SLAC-PUB–5049) **The high-gradient S-band linac for initial acceleration of the SLC [SLAC linear collider] intense positron bunch.** Clendenin, J.E.; Ecklund, S.D.; Hoag, H.A. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–2: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89015637/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Although short lengths of S-band standing-wave, disk-loaded waveguide have been successfully RF-processed to accelerating gradients equivalent to about 175 MeV/m in a traveling-wave structure, the 20 MeV/m gradient of the SLC 50 GeV linac has been the highest gradient S-band accelerator in operation. However, the 1.5 m traveling-wave constant impedance capture section for the SLC positron source, operating with a dedicated 60 MW klystron, is now routinely accelerating single-bunch beams of more than 7×10^{10} e^+/pulse at rates of up to 60 Hz with an accelerating gradient section are described. 11 refs., 1 fig. 1 tab.

45937 **Methods of stability analysis in nonlinear mechanics.** Warnock, R. L. (Stanford Linear Accelerator Center, Stanford University, Stanford, California 94309(US)); Ruth, R. D.; Gabella, W.; Ecklund, K. *AIP Conference Proceedings (American Institute of Physics) Conference Proceedings (USA)*, 184(1): 995-1014 (1 Apr 1989). DOE Contract AC03-76SF00515;FG02-86ER40302. (CONF-8707208–: U.S. Particle Accelerator School: physics of particle accelerators, 20 Jul - 14 aug 1987).

We review our recent work on methods to study stability in nonlinear mechanics, especially for the problems of particle accelerators, and compare our ideas to those of other authors. We emphasize methods that (*a*) shows promise as practical design tools, (*b*) are effective when the nonlinearity is large, and (*c*) have a strong theoretical basis.

4303 Auxiliaries and Components

Refer also to citation(s) 45821, 45822, 45823, 45911, 45973, 46193, 46514, 46582

45938 (BONN-IR–88-60) **Polarized target physics at the Bonn electron accelerators.** Meyer, W. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Dec 1988. 93p. Order Number DE89915123/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

At the BONN 2.5 GeV electron synchrotron experiments with polarized nucleon targets have a long tradition. Starting with measurements of the target asymmetry in single pion photoproduction off polarized protons, resp. neutrons, the experiments have been concentrated on photodisintegration measurements of polarized deuterons. Parallel to these activities a considerable progress in the field of the target technology, e.g. cryogenics and target materials, has been made, by which all the measurements have profitted enormously. Especially the development of the new target material ammonia has allowed the first use of a polarized deuteron (ND_3) target in an intense electron beam. The construction of a frozen spin target, which will be used in combination with a tagged polarized photon beam, makes a new generation of polarized target experiments in photon induced reactions possible. Together with electron scattering off polarized deuterons and neutrons they will be a main activity in the physics program at the new stretcher accelerator ELSA in BONN. (orig.).

45939 **RF system considerations for a large hadron collider.** Raka, E. (Brookhaven National Lab., Upton, NY (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The radio-frequency (rf) system of a large hadron collider is required to operate in three different modes. It must capture and accumulate in stationary buckets (closed trajectories in longitudinal phase space) successive groups of bunches from its injector; accelerate these bunches in moving buckets up to the design energy; and finally store them, for several hours, while maintaining a minimum ratio of bunch-to-bucket area. In the storage mode it provides the nominal energy gain per turn required to make up for synchrotron radiation losses and for the power loss due to voltages induced in the impedances presented to the beam by the vacuum chamber and accelerating structures. Each of these modes requires its own set of rf system parameters, i.e. frequency, total gap voltage, power, etc. For conventional machines such as the NAL main ring or the CERN SPS the voltage and power requirements were determined by the acceleration mode since beam storage was not considered in their design. The choice of frequency 53-MHz standing-wave cavities at NAL and 200-MHz traveling-wave structure at CERN was based primarily on rf engineering considerations. For a large hadron collider the storage mode requirements can be the determining factors in the choice of peak voltage and frequency. This paper discusses how to arrive at a particular choice of voltage

and frequency; the type of acceleration structure that would be suitable for obtaining the required voltage and resonant impedance; static beam loading including a simplified beam stability criterion involving the beam current and total rf system shunt impedance; the basic principle of rf phase and frequency control loops; and the effect of rf noise and its interaction with these loops. Finally, the need for and design of RF systems to damp independently coherent oscillations of individual bunches or groups of bunches is considered. 30 references, 18 figures, 2 tables.

45940 Characteristics of synchrotron radiation. Kim, K. (Lawrence Berkeley Lab., CA (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00098. (CONF-8808234--Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Synchrotron radiation - the radiation produced by a charged particle moving with relativistic speed in curves trajectories - is playing an increasingly important role in many areas of basic and applied sciences. It provides intense, laser-like flux of photons in a wide range of spectral regions not accessible with other sources. In this paper, the principle of various synchrotron radiation sources and their characteristics are reviewed. There are three kinds of synchrotron radiation sources, bending magnets, wigglers, and undulators. In bending magnets, electrons move in a circular trajectory, producing a smooth spectrum. Wigglers can be regarded as a sequence of bending magnets of alternate polarities. Thus, the radiation characteristics are similar to those from bending magnets, apart from a 2N-fold enhancement of the intensity, where 2N is the number of the poles. An undulator is a N-period magnetic structure producing a gentle, periodic orbit. Because of the interference of radiation from different parts of the trajectory, the undulator radiation is squeezed into discrete spectrum and narrower emission angles. The result is an N_2-fold enhancement of the angular density of the flux in the forward direction. The spectral characteristics of radiation from bending magnets, wigglers and undulators are schematically illustrated. 41 references, 37 figures.

45941 Radio-frequency acceleration. Puglisi, M. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

In the early days of cyclic RF accelerators the number of particles orbiting inside the machine was so small that the RF accelerating system was the least expensive and the most simple part of the machine. Less than twenty years later the situation was very much changed and now the opposite is true. The intensity of the accelerated current is so high and the required performances are so high that the RF accelerating systems are now a very sophisticated and expensive part of the whole machine. Moreover, it should be added that the major limitations to the possibility of an orbital machine now only come from the RF system. The same applies to linear accelerators where the machine itself is (as it was at the beginning) an RF device. Again at the dawn of the electromagnetic accelerators the linear accelerator was a small RF system with a very limited task. Now a tremendous effort is being made around the world to increase the fields and the intensity of the accelerated beam and this is generating a family of linear accelerators of increasing cost and complexity. 7 references, 35 figures, 1 table.

45942 Principles and technology of RFQs. Schempp, A. (Universitaet Frankfurt (West Germany)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The RFQ is a linear accelerator structure for low velocity ions which focuses and accelerates with the help of electrical radio-frequency (rf) quadrupole fields. It was first proposed by Kapchinskij and has since been applied in numerous labs mainly as injector for Alvarez accelerators. The RFQ can simultaneously focus, bunch, and accelerate a high current beam directly from the ion source, which can be on a relatively low dc potential. This allows the use of special ion sources which can be bulky and can have high power consumption like sources for polarized or highly charged ions. First, general principles of RFQ accelerators and typical limits imposed by particle dynamics are presented. Second typical problems of rf and mechanical design of this new type of accelerator are discussed, with the RFQ injectors built for DESY as examples to demonstrate typical properties of this type of low energy, high current injector. 28 references, 18 figures.

45943 Photocathode RF guns. Sheffield, R.L. (Los Alamos National Lab., NM (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Free-electron oscillators and amplifiers require electron accelerators capable of delivering pulse trains of electron bunches of high charge density in a wiggler or undulator. A high electron density implies a high peak current (100 A to 2000 A) and a low transverse beam emittance ($< 80\ \pi \times$ mm $\times$ mrad, determined by matching the transverse size of the electron beam to the optical beam in the wiggler). Electron beam collider machines also require high peak currents ($>$ 8 nC in picoseconds) with extremely small emittances ($< 10\ \pi \times$ mm $\times$ mrad). Several approaches have been proposed to attain such performance. This article discusses the use of photocathodes in attaining the aforementioned performance requirements. Photocathodes have been used as electron sources in lasertrons and for the production of spin-polarized electrons. A photocathode is a light-activated electron source that gives unprecedented control over all aspects of the electron distribution: peak current, spatial profile, and temporal profile. This control is possible because the electron distribution is not determined by grids or a cathode, but rather by an incident laser pulse on the photocathode. 44 references, 21 figures.

45944 Low emittance thermionic electron guns. Herrmannsfeldt, W.B. (Stanford Linear Accelerator Center, CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The author discusses self-field effects and external field effects for electron guns. He also discusses designs of electron guns and their uses in electron cooling systems and as an injector for electrostatic free electron lasers. He closes by looking at electron guns for linear accelerators. 20 references, 3 figures.

45945 Intense, low emittance injectors for RF electron linacs. Smith, T.I. (Stanford Univ., CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

A workshop on low emittance beams was held at Brookhaven National Laboratory from March 20 to March 25, 1987. The workshop was held under the auspices of the International Committee on Future Accelerators (ICFA), and was intended to explore issues relating to the production of electron beams with an unprecedented combination of high charge density and low emittance. The following material is largely a result of discussions held during the workshop, and represents an attempt to estimate the severity of some of the problems which would be encountered in the design of an RF linac injector consistent with the workshop goals. 12 references, 1 figure, 1 table.

45946 Free-electron lasers. Brau, C.A. (Vanderbilt Univ., Nashville, TN (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234--Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Free-electron lasers represent an altogether new and exciting class of coherent optical sources. Making use of a simple and elegant gain medium - an electron beam in a magnetic field - they

have already demonstrated broad tunability and excellent optical-beam quality. For the future they offer the possibility of generating the greatest focused power ever achieved by a laser. Even before this is achieved, the unique advantages of free-electron lasers, especially their tunability, will make them useful for a variety of important applications in science and medicine. The purpose of this chapter is to introduce the broad field of free-electron lasers before launching into the details of their operation and the technologies which support them. The chapter begins with a brief history of free-electron lasers, and then continues with a simple discussion of the basic principles of their operation. This is followed by a survey of the experiments which have been accomplished to date, and finally a discussion of some of the applications for which free-electron lasers seem particularly well suited. 116 references, 42 figures.

45947 Free-electron lasers. Pantell, R.H. (Stanford Univ., CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The purpose of the free-electron laser (FEL) is to convert the kinetic energy of an electron beam to electromagnetic energy. There are two primary components to the FEL: (1) A device for providing energetic particles. (2) A device for converting particle kinetic energy to radiation. Thus far, there has been a greater variety of approaches in the first category than in the second. To achieve energy transfer between a particle beam and a wave over an extended distance requires a synchronism condition between the electron velocity and the phase velocity of the wave. This presents a problem since, in vacuum, a plane wave has a phase velocity equal to c, the velocity of light, and the electrons have a velocity v such that $v < c$. In addition, since the electrons enter the system uniformly distributed along the direction of motion, bunching must occur so that a majority are in a phase of the field for which the wave extracts energy from the particles. At microwave frequencies the synchronism problem may be solved by using a periodic structure, as in a linac or TWT, such that a component of the wave that is established to match the periodic boundary propagates with a phase velocity equal to or less than c. This is not a good solution for infrared and visible wavelengths. 9 references, 17 figures, 1 table.

45948 Fundamentals of intense relativistic electron beams. Miller, R.B. (TITAN Technologies, Albuquerque, NM (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

An intense charged particle beam can be characterized as an organized charged particle flow for which the effects of beam self-fields are of major importance in describing the evolution of the flow. Research employing such beams is an important field with applications ranging from the development of high power sources of coherent radiation to inertial confinement fusion. In this series of lectures the primary goal is to provide a basic description of intense beam transport in a variety of situations of practical importance. First a brief summary is presented of the development of the pulse power technology which is often used to generate these beams, followed by an elementary description of intense beam behavior based on single-particle beam envelope equations. Then the author describes in some detail the behavior of intense beams in high-voltage diodes, and the important processes involved in beam transport in vacuum, in plasma, and in neutral gas. Much of this material is taken from my book, An Introduction to the Physics of Intense Charged Particle Beams (Plenum, 1982), which may be consulted for more information and references. 12 figures, 1 table.

45949 Coherence and statistical properties of photon beams with application to the free-electron laser. Bhattacharjee, A. (Columbia Univ., New York, NY (USA)); Gjaja, I. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The subject of quantum optics has undergone considerable development in the last twenty-five years. Spurred by the invention of the laser, the theoretical understanding of the coherence and statistical properties of optical beams has now attained a stage of maturity where it is possible to treat different kinds of light sources. Over approximately the latter half of this period of development in quantum optics, the free-electron laser (FEL) has been developed to the point where it is now regarded as a tunable light source of considerable versatility, with prospects of producing radiation over a wide range of wavelengths at large levels of power. Since the basic mechanism for radiation gain in an FEL can be understood in classical terms, much of the literature on the subject does not need to venture outside the domain of classical physics. However, it is natural that the coherence and statistical properties of photon beams produced by FEL's should be investigated as they are in conventional lasers, and that a quantum theory of the FEL should be necessary for this purpose. In this paper, the theory of coherence and statistics of photon beams is reviewed in general, with application to the FEL in particular. As far as the general theory is concerned, this paper may be regarded as a poor man's version of existing wisdom in quantum optics. The attempt here has been to distill the existing principles in a compact, self-contained way that will enable one to use them for a light source such as the FEL, which is the application of interest in this paper. 22 references, 1 figure.

45950 Antiproton source. Peoples, J. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

In the past 18 months the Antiproton Source and the Collider have evolved from designs under construction into real machines. On October 11, 1985, a few days before the start of a year-long shutdown to build the DO collision hall, the $\bar{p}$ Source stored 10^{10} antiprotons. On October 12 and 13 these antiprotons were accelerated to 800 GeV in the Tevatron and brought into collision with 800-GeV protons. In late 1986 the $\bar{p}$ Source and the Tevatron Collider were in their early stages of use, but their promise should be fulfilled in 1987. The Tevatron I project is Fermilab's entry into the colliding beam sweepstakes. It is an extraordinary one, largely because it will be the highest energy collider, by nearly a factor of three, until the early 1990's. It has already reached 1.6 TeV and is expected to approach 2 TeV within the next two years. Collisions take place in the Tevatron, the superconducting proton synchrotron that the Accelerator Division Staff built and commissioned as the Energy Saver over the past five years. This ring was transformed into a collider as part of the Tevatron I project, although strictly speaking only a few additions were needed to make this transformation. Since the Tevatron Collider has been described in other chapters in this book, only the performance specifications and their implications for physics are discussed here. 27 references, 18 figures, 5 tables.

45951 Resonant extraction at the tevatron. Harrison, M. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

At the most basic level, extraction is the process of persuading a circulating beam to leave the machine in a controlled fashion. This is accomplished by deflecting a certain proportion of the circulating beam away from the central machine orbit and into the start of the extraction channel, from which point it is then shaped and split before entering the experimental areas. Deflecting the beam into the extraction channel is achieved by moving the beam across a thin electrostatic septum. Several potentially applicable techniques are available for doing this. For a variety of reasons the method chosen to be implemented at the Tevatron was that of horizontal half-integer resonant extraction. Under this scenario the beam is slowly moved into a nonlinear resonance where the incoherent betatron amplitudes grow in a controlled way from turn to turn until the amplitude is large enough for deflection into the extraction channel.

This chapter starts by examining the resonant process. Then the effect of the finite machine aperture on extraction efficiency is shown. The specific layout of the extraction elements in the Tevatron is given, together with how they are used. Then the operational characteristics of the system is considered. Results from a Monte Carlo simulation of fast extraction are presented. The paper is concluded with a brief discussion of measurements and calculations of energy deposition in the superconducting magnets resulting from the beam losses incurred during the fast spill. 17 figures.

45952 **Design and operation of the quench protection system for the Fermilab tevatron.** Martin, P.S. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The operation of a superconducting accelerator, in addition to cryogenic requirements, introduces a new complexity not present in a conventional accelerator. A method is required for protecting the magnets from possible overheating or overvoltage conditions in the event that some magnets quench, that is, are elevated in temperature so that they are no longer superconducting. The development of that system is the topic of this chapter. Any quench protection system has two very important ingredients. First, it must be designed with sufficient integrity to remain functional even under abnormal circumstances. The magnets must be protected during power failures, for example. Quenches involving a large number of components can also be hazardous because of the redistribution of voltages during the quench. Some of the system integrity can be achieved through redundancy. Frequent testing of critical elements of the system also assures the overall integrity. Second, the quench protection system must protect against damage from quenches regardless of their location or the excitation current at the time. It is not sufficient to protect just the magnet coils; either the leads between magnets must be fully stabilized or the quench protection system must protect them. The next section presents a brief discussion of the basic properties of superconductors and the phenomenon of quench propagation. 10 references, 13 figures.

45953 **Technology and particle beams.** Hartill, D.L. (Cornell Univ., Ithaca, NY (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Particle beams have been developed over the past sixty years by physicists in order to do scattering and production experiments in high energy physics. The earliest beams were the alpha-particle beams from natural radioactive sources used by Rutherford to perform scattering experiments that led to the discovery that the atomic nucleus was very small in diameter compared to atomic diameters. Over this period the technology has ranged from MeV energy proton beams produced by dc and electrostatic generators to modern colliders which collide beams of antiprotons with protons at beam energies of 900 GeV. To contain these energetic beams large-scale superconducting magnets had to be developed and are now in routine use at Fermilab. The proposed SSC which consists of two superconducting magnet rings with protons circulating in opposite directions will provide collisions between 20-TeV protons. The scale of these machines has gone from tens of centimeters to 100 kilometers for the circumference of the SSC in the space of fifty years. The field of particle physics is at the most fundamental level of scientific research since it studies the forces and particle constituents of nature's particles that are the building blocks of matter as we know it. This field has an extensive literature and for the rest of this overview only the technological applications of particle beams will be considered. 11 references, 3 figures.

45954 **General overview and a review of storage rings, research facilities, and insertion devices.** Winick, H. (Stanford Synchrotron Radiation Lab., CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-82ER13000. (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Synchrotron radiation, the electromagnetic radiation given off by electrons in circular motion, is revolutionizing many branches of science and technology by offering beams of vacuum ultraviolet light and x rays of immense flux and brightness. In the past decade there has been an explosion of interest in these applications leading to increased exploitation of existing rings and activity to construct new research facilities based on advanced storage rings and insertion device sources. Applications include basic and applied research in biology, chemistry, medicine, and physics plus many areas of technology. In this article they present a general overview of the field of synchrotron radiation research, its history, the present status and future prospects of storage rings and research facilities, and the development of wiggler and undulator insertion devices as sources of synchrotron radiation. 66 references, 20 figures, 1 table.

45955 (DOE/FTR–9015526) **[Ion sources, electron guns and beam optics]: Foreign trip report, June 7–14, 1989; July 1–19, 1989.** Prelec, K. Brookhaven National Lab., Upton, NY (USA). 7 Aug 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. Order Number DE89015526/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Advanced Source Development Group at BNL is currently involved in feasibility studies to replace heavy ion beams from a tandem accelerator with a possibly much more efficient and reliable EBIS, coupled with an RFQ accelerator. Discussions with Dr. Liljeby of the M. Siegbahn Institute and with Professor M. Sedlacek of the Royal Institute of Technology were focused on the BNL approach in the design of an electron gun or such a source. In addition, I got acquainted with Dr. Liljeby's experience in the operation of their EBIS. CERN Laboratory in Geneva, Switzerland, is presently considering acceleration of lead ions in their SPS (with a fixed target), as well as acceleration of heavy ions in the proposed Large Hadron Collider (LHC), in the colliding mode similar to BNL's RHIC project. Discussions were held with Drs. H. Haseroth and K. Schindl on both the LHC and RHIC projects. With Ch. Hill, who is in charge of the CERN preinjectors, experiences were compared with volume H^- ion sources, while discussions with M. Weiss were a follow-up of the joint work going on since 1984 on ion optics and RFQ acceleration.

45956 (FNAL-TM–1595) **SSC superconducting dipole magnet cryostat model style B construction experience.** Engler, N.H.; Bossert, R.C.; Carson, J.A.; Gonczy, J.D.; Larson, E.T.; Nicol, T.H.; Niemann, R.C.; Sorensen, D.; Zink, R. Fermi National Accelerator Lab., Batavia, IL (USA). Mar 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-890270–22: International industrial symposium on the super collider, 8-10 Feb 1989). Order Number DE89015971/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A program to upgrade the full scale SSC dipole magnet cryostat model function and assembly methods has resulted in a series of dipole magnets designated as style B construction. New design features and assembly techniques have produced a magnet and cryostat assembly that is the basis for Phase 1 of the SSC dipole magnet industrialization program. Details of the assembly program, assembly experience, and comparison to previous assembly experiences are presented. Improvements in magnet assembly techniques are also evaluated. 6 refs., 5 figs.

45957 (FNAL-TM–1597) **Piping instability resulting from bellows misalignment.** Nicol, T.H. Fermi National Accelerator Lab., Batavia, IL (USA). 30 May 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89015586/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The failure of the single phase bellows and magnet test stand during quench testing of SSC dipole magnet DD0011 has led to much speculation about the inherent stability of operating SSC magnets. This note addresses the problem of instabilities resulting from both translational and angular misalignment between pipes connected by bellows in the general sense and with respect to the SSC single phase system specifically. Note that none of the instabilities referenced here result from bellows 'squirm'. Inelastic bellows failure is not within the scope of this work. The failure mode referenced here is an elastic instability. 3 refs., 7 figs.

45958 (FNAL-TM–1600) **A Main Ring bunch length monitor by detecting two frequency components of the beam.** Ieiri, T.; Jackson, G. Fermi National Accelerator Lab., Batavia, IL (USA). 2 Jun 1989. 25p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89014016/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The bunch length is measured by detecting two revolution frequency harmonics of the beam and taking the ratio of their amplitudes. Two heterodyne receivers have been made to direct them, one at 53MHz and the other at 159MHz. These signals are picked-up by a stripline detector. An analog circuit provides a signal proportional to the bunch length. The monitor measures variation of the bunch length as a function of time in the Main Ring. The measured signal, which sometimes shows that the bunches are tumbling in phase space, can be damped by feedback to the RF amplitude modulator. 9 refs., 12 figs., 1 tab.

45959 (INIS-BR–1570) **Design, construction and test of a corrector coil set for magnetic field homogenization of a dipolar magnet.** Pires, L.R. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1987. 89p. (In Portuguese). Order Number DE89636444/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

A method to improve the homogeneity of the distribution of the magnetic flux density in the gap of a dipole magnet. It is based on correcting the magnetic field by means of a system of coils, which employs etching thin copper foils, similarly as those for electronic circuits, is presented. The advantage of this method lies on its simplicity, its small space use, and its low price. The method was applied to correct the field of a dipole magnet, and it worked properly. (author).

45960 (LA-UR–89-2792) **Rf deflector-chopper for SSC [Superconducting Super Collider] injector.** Guy, F.W.; Bhatia, T.S. Los Alamos National Lab., NM (USA). [1989]. 6p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-36. (CONF-890803–6: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89016976/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In a proposed SSC linac injector the Low-Energy Booster lattice painting scheme requires a 50-MHz microbunch structure with transverse and longitudinal normalized rms emittances of less than 0.45 π-mm-mrad and 1.7×10^{-5} $\pi \cdot eV \cdot s$, respectively, at 600 MeV. A 50-MHz RFQ design does not meet the longitudinal emittance requirements; a 150-MHz RFQ can do so, but requires a chopping scheme that produces a clean 50-MHz beam structure without degrading emittance. We present an rf deflector-chopper conceptual design that converts a 150-MHz RFQ beam into a 50-MHz microbunch beam structure while matching transversely and longitudinally to a following 450-MHz DTL. Multiparticle simulation with 3-D space charge shows negligible emittance growth. Output beam emittances are factors of 3 below requirements; further acceleration to 600 MeV should produce only small additional growth. The chopper is 54 cm long, comprising an rf deflector, two rebunchers, five small permanent magnet quadrupoles, and a beam dump. Similar schemes could use a 200- or 250-MHz RFQ for even smaller longitudinal emittance. 6 refs., 5 figs., 2 tabs.

45961 (LBL–26824) **Testing of a H_2^+ enriched ion source for deuterium simulation.** Williams, M.D.; Leung, K.N.; Brennen, G.M.; Burns, D.R. Lawrence Berkeley Lab., CA (USA). Jun 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-890703–16: International conference on ion sources, 9-15 Jul 1989). Order Number DE89015968/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have tested a McDonnell Douglas short multi-cusp plasma generator, designed to generate a positive hydrogen ion beam which is enriched with H_2^+ ions. Initial testing shows that the prototype source is capable of producing a positive hydrogen ion beam with H_2^+ percentage greater than 85%. The total ion current density was 56 mA/cm^2. For a higher current density of 110 mA/cm^2, the percentage of H_2^+ ions is approximately 73% as measured by a magnetic deflection spectrometer. A comparison between tungsten and lanthanum hexaboride cathodes shows that tungsten filaments can provide better performance. We have also operated the Berkeley 7.5-cm-diam. multicusp source without the magnetic filter. It is found that this source is also capable of generating H_2^+ fractions larger than 75%. 7 refs., 6 figs.

45962 (SAND–89-7073) **Aurora oil switch upgrade program.** Warren, T. Sandia National Labs., Albuquerque, NM (USA); Physics International Co., San Leandro, CA (USA). Mar 1989. 69p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE89015192/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This report describes the short pulse synchronization requirements, the original Aurora trigger scheme, and the PI/SNLA approach to improving the synchronization. It also describes the oil switching design study undertaken as the first phase of the program. A discussion of oil-switch closure analysis and the conceptual design motivated by this analysis are presented. This paper also describes the oil-switch trigger pulser tests required to validate the concept. This includes the design of the testing facility, a description of the test goals, and a discussion of the results. This paper finally describes oil-switch trigger pulser testing on one of the four Aurora Blumlein modules, which includes the hardware design and operation, the testing goals, hardware installation, and test results. 9 refs., 26 figs.

45963 (SLAC–340) **Optical tuning in the arcs and final focus sections of the Stanford Linear Collider.** Bambade, P.S. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Mar 1989. 224p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. Order Number DE89015620/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

In this thesis, we present the experimental tuning procedures developed for the Arcs and for the Final Focus Section of the Stanford Linear Collider (SLC). Such tuning is necessary to maximize the luminosity, by minimizing the beam size at the interaction point, and to reduce backgrounds in the experiment. In the final Focus Section, the correction strategy must result from the principles of the optical design, which is based on cancellations between second order aberrations, and on the ability to measure micron-size beams typical of the SLC. In the Arcs, the corrections were designed after the initial commissioning, to make the system more error-tolerant, through a modification in the optical design, and to enable adjustments of the beam phase-space a the injection to the Final Focus System, through a harmonic perturbation technique inspired from circular accelerators. Although the overall optimization of the SLC is not entirely finished, an almost optimal set-up has been achieved for the optics of the Arcs and of the Final Focus Section. Beams with transverse sizes close to the nominal ones, of a few microns, have been obtained at the interaction point. We present and discuss our results and the optical limits to the present performance. 24 refs., 25 figs., 2 tabs.

45964 (SLAC-PUB–5026) **An immersed field cluster klystron.** Palmer, R.B.; Herrmannsfeldt, W.B.; Eppley, K.R. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–3: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89015633/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Future linear colliders have a need for high power, high frequency, and short-pulse radio frequency sources. The proposed "cluster klystron" should give over 1 GW of 12 GHz radio frequency power, can employ direct current or a long high-voltage pulse, but can be gated to give pulses down to a few tens of nanoseconds. The device consists of 42 parallel 100 A channels. Each channel is fed from an individual magnetron-type gun employing a common 50 kV mod-anode. The beams are accelerated to 400 kV in common dc accelerating gaps and fed into the 42 separate klystron channels. Focusing of all channels is achieved by a single overall 4 kG magnetic field. Simulations of expected performance suggest that the efficiency could be above 70%. 10 refs., 6 figs., 5 tabs.

45965 (SLAC-PUB–5034) **Bunch compression for the TLC [TeV Linear Collider].** Kheifets, S.A.; Ruth, R.D.; Fieguth, T.H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–8: International conference on

high energy accelerators, 20-26 Aug 1989). Order Number DE89016944/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The length of the bunch for the TeV Linear Collider (TLC) must be decreased, while simultaneously preserving its small transverse emittance. To achieve a short bunch length ($\sim$ 70 μm) needed for the TLC, it is necessary to use two-step compression of a 5 mm bunch which is extracted from the damping ring. The corresponding increase of momentum spread requires that chromatic aberrations of the transport line must be corrected at least up to second order. This goal is achieved by building the compressor out of second-order achromats, which also eliminates geometric aberrations. The utilization of flat beams restricts the design to an uncoupled, mid-plane symmetric transport line. The first compression is performed by a conventional compressor. For the second, it is possible to use a 180° bend. The emittance growth due to the synchrotron radiation is kept to several percent. 10 refs., 3 tabs.

45966 (SLAC-PUB–5050) **Energy matching of 1.2 GeV positron beam to the SLC [Stanford Linear Collider] damping ring.** Clendenin, J.E.; Helm, R.H.; Jobe, R.K.; Kulikov, A.; Sheppard, J.C. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–1: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89015638/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Positrons collected at the SLC positron source are transported over a 2-km path at 220 MeV to be reinjected into the linac for acceleration to 1.2 GeV, the energy of the emittance damping ring. Since the positron bunch length is a significant fraction of a cycle of the linac-accelerating RF, the energy spread at 1.2 GeV is considerably larger than the acceptance of the linac-to-ring (LTR) transport system. Making use of the large pathlength difference at the beginning of the LTR due to this energy spread, a standard SLAC 3-m accelerating section has been installed in the LTR to match the longitudinal phase space of the positron beam to the acceptance of the damping ring. The design of the matching system is described, and a comparison of operating results within simulations is presented. 5 refs., 4 figs., 1 tab.

45967 (SLAC-PUB–5054) **A 2-MeV microwave thermionic gun.** Tanabe, E.; Borland, M.; Green, M.C.; Miller, R.H.; Nelson, L.V.; Weaver, J.N.; Wiedemann, H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8909183–1: 14. meeting on linear accelerators, 7-9 Sep 1989). Order Number DE89015640/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A high-gradient, S-band microwave gun with a thermionic cathode is being developed in a collaborative effort by AET, Varian, and SSRL. A prototype design using an upgraded Varian dispenser cathode mounted with thermal isolation directly in the first half-cell of a 1-1/2 cell, side-coupled, standing-wave cavity has been fabricated and is being tested. Optimization of the cavity shape and beam formation was done using SUPERFISH, MASK, and PARMELA. An overview of design details, as well as the status of in-progress beam tests, will be presented. 9 refs., 6 figs.

45968 (SLAC-PUB–5059) **Field emission and rf breakdown in copper linac structures.** Loew, G.A.; Wang, J.W. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-890803–9: International conference on high energy accelerators, 20-26 Aug 1989). Order Number DE89016949/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper presents a status report on rf field emission and high-gradient breakdown studies in linac structures at SLAC. The motivation behind these studies, begun in 1984, is to determine the maximum accelerating field gradients that could be used safely in future $e^{\pm}$ colliders, to contribute to the basic understanding of the rf breakdown mechanism, and to discover if special surface treatments might make it possible to shorten the time needed for rf processing and to supersede the field limits presently reachable in room temperature copper structures. Both theoretical ideas and experimental results are discussed. 8 refs., 3 figs., 1 tab.

45969 (UCRL–100366) **A new streak tube design with a high signal to noise ratio and fast time response.** Bowers, M.W. Lawrence Livermore National Lab., CA (USA). 11 Jul 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890836–9: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, 6-11 Aug 1989). Order Number DE89016500/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A new streak tube is in the preliminary design and review phase. Modeled after the newly designed microchannel-plate (MCP)-based x-ray-framing camera at the Lawrence Livermore National Laboratory (LLNL), this streak tube incorporates an MCP at the light input to amplify the signal before noise is introduced into the system. The signal-to-noise ratio of the streak tube is directly dependent on the gain setting of the MCP and can thus be greater than 1000:1. Temporal resolution will be about 30 ps, and the dynamic range should be greater than 500:1. Another tube of the same design, but employing a photocathode instead of the photocathode/MCP combination, has been studied briefly. With some minor modifications, it should be possible to achieve a dynamic range of about 20 with this version of the design, and to reduce the magnification to about 1 and improve the time response to 150 fs. 4 refs., 5 figs.

4304 Storage Rings

Refer also to citation(s) 45899, 45900, 45902, 45927, 46432

45970 Bunched beam diagnostics. Siemann, R.H. (Cornell Univ., Ithaca, NY (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

There is a remarkable diversity in the field of accelerator physics. Look at the proceedings of any conference. Papers range from Hamiltonian dynamics to the latest improvements of performance in accelerator X to the engineering of specialized equipment. Beam diagnostics is somewhere in the middle of this. Diagnostic instruments make the connection between theories and observations, and the capabilities of these instruments influence strongly our ability to improve performance. The gave a series of lectures in 1987 on the general topic of Principles of Beam Observation. The emphasis was on frequency domain analysis of beam generated signals in storage rings, and that is the subject of this paper. The goal is to connect spectrum analyzer observations to what the beam is doing. In addition, understanding beam spectra is essential for understanding coherent effects and instabilities in storage rings, and this is discussed extensively. 23 figures, 4 tables.

45971 Fields, impedances, and structures. Ng, K. (Fermi National Accelerator Lab., Batavia, IL (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

Beam particles interact directly with other beam particles or indirectly through the electromagnetic fields reflected back from the walls of the vacuum chamber. The interaction between the fields and a bunch may lead to coherent motions of the particles inside the bunch resulting in instabilities. For the SSC, the bunch intensity is very low because they want to limit the event rate at collision. Thus the single-bunch instabilities encountered in bunched beam storage rings may not be an important issue here. However, in order to reach a designated luminosity, the number of bunches is enormous. The electromagnetic fields inside the vacuum chamber can couple bunches together and let them oscillate coherently, leading to multi-bunch instabilities. A real impedance will cause parasitic beam energy loss. This will cause heating of the vacuum chamber, some of which occurs at liquid helium temperature and thus contributes to the cryogenic load. The space-charge impedance will lead to a tune shift in single-particle betatron motion,

which can increase the transverse beam size and even lead to instability. For other machines such as an electron storage ring, the rate of interaction decreases sharply with energy. To maintain a certain event rate, it would be preferable to have a particle beam with as high an intensity as possible and as small emittances as possible. Although there are techniques to attain high intensity and low emittances, they are often limited by single-bunch instabilities. As a result, these impedances must be kept low enough for a beam of high luminosity to be possible. In this chapter, the electromagnetic fields left by a particle after traversing some structures of the vacuum chamber is discussed. Next, coupling impedances are defined in terms of the wakefields. They are then estimated for various discontinuities in the chamber. 24 references, 17 figures, 1 table.

45972 Advanced nonlinear theory: long-term stability at the SSC. Heifets, S. (Continuous Electron Beam Accelerator Facility, Newport News, VA (USA)). pp. 1136 of Physics of particle accelerators. Volume 1. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.1-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The SSC is supposed to be one of the most stable dynamic systems. The luminosity lifetime of one day means that particles have to be in regular, stable, bounded motion for 10_8 revolutions. This is only an order of magnitude less than the lifetime of the solar system. The problem of beam stability, one of the main problems in the theory of accelerators, has many aspects: one-particle dynamics, and intrabeam, beam-environment, and beam-beam interactions. Here only the first problem - the dynamics of a single particle is addressed. 36 references, 9 figures.

45973 Superconducting magnet system. Dahl, P. (Brookhaven National Lab., Upton, NY (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The superconducting magnet system for the SSC is unprecedented in technical scope and, manifestly, the costliest machine component as well. A total of 7680 superconducting dipoles are required for bending the two proton beams in the regular arcs of the lattice, 1356 quadrupoles for focusing, and $\sim$ 1600 spool pieces housing correction windings and other instrumentation. In addition, $\sim$ 650 special magnets are required to bring the two counter-rotating beams into collision in the interaction regions of the experimental areas. Altogether, the magnet system comprises nearly 13,000 superconducting magnets representing an investment of three quarters of a billion dollars. The most critical magnets, because of their demanding operating specifications and sheer number, are the regular dipoles; consequently, the design effort has concentrated on them. The dipole field strength determines the circumference of the collider rings and thus the cost of the tunnel. Therefore the operating field is chosen to be as high as practical, consistent with a judicious balance between sound magnet design principles and minimum unit cost. The minimum required coil aperture (coil i.d.) and available superconductor current density dictate the overall magnet size and hence its cost. (The superconductor alone accounts for $\sim$ 30% of the cost.) The good-field aperture must be large enough to accommodate the circulating beam, particularly at injection. The uniformity of the magnetic field determines the lifetime of the stored beams. The operational life of the collider facility and fraction on time for physics experiments depends on magnet reliability and on a conservative design. It goes without saying that the feasibility of large superconducting magnet systems is partly due to concomitant progress in large-scale helium refrigeration technology. 13 references, 22 figures, 11 tables.

45974 SSC project. Peoples, J. (Lawrence Berkeley Lab., CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The SSC is a 20-TeV, proton-proton collider proposed for construction by the US Department of Energy (DOE). Completion is planned for the mid-1990s. A technical description of the accelerator is given along with a report on the status of the project. 8 references, 3 figures, 5 tables.

45975 Parameter choices for the SSC. Peterson, J.M. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The design of the Superconducting Super Collider has followed from the basic requirement that it produce observable reactions among the elementary constituents of matter at as high an energy as now possible. The basic design parameters are that proton beams of 20 TeV be brought into collision at six interaction points in such a way as to produce a luminosity of 10^{33} $cm^{-2}s^{-1}$ per collision point. A collider arrangement is chosen to reach the highest possible energy. A 20-TeV proton collider provides 40 TeV of available energy in the center of mass, whereas a 20-TeV fixed-target proton machine has only 0.194 TeV in the center of mass of a proton-nucleon collision. The energy of 20 TeV for each beam is determined by the particle physics to be investigated. High in priority will be new particles with masses in the TeV range that are produced by parton-parton (quark, anti-quark, gluon) collisions. Since each parton carries on the average only a third or so of the proton beam energy, 20 TeV is a practical minimum for investigating this physics domain. A proton-proton collider, rather than a proton-antiproton collider, is chosen because of the greater intensity that can be obtained with protons. Although the antiproton, because of its antiquark composition, would be inherently advantageous in producing some new particles, this small advantage is outweighed by the greater (x10) luminosity available in proton-proton machines. 3 references, 4 figures, 1 table.

45976 Supercollider physics. Quigg, C. (Lawrence Berkeley Lab., CA (USA)). pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The first order of business will be to summarize the microscopic description of matter. The author reviews the evidence for quarks and leptons as fundamental constituents and explains the strategy of gauge theories of the fundamental interactions. Next, he discusses questions the Standard Model raises but cannot answer. A frontier where the current understanding ceases to make sense, where the clues that will lead us to a more satisfying description of Nature will have to be found can be defined. That frontier lies at energies of about 10^{12} electron volts for collisions among the fundamental constituents. The instrument of choice for reaching this new energy scale is a high-energy, high-luminosity, proton-proton collider. He concludes by summarizing the status of the American project known as the Superconducting Super Collider, or SSC. 13 figures.

45977 (SLAC-PUB–5038) **Design of a high luminosity collider for the Tau-Charm Factory.** Oide, Katsunobu. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–6: Tau-Charm workshop, 23-27 May 1989). Order Number DE89015635/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Important relations between basic parameters of a high-luminosity collider are discussed. As the result, it is shown that the maximum bunch spacing is limited by the beam current to clear the threshold of the bunch lengthening. In order to solve the short bunch spacing, the crab-crossing scheme is applied to the design of a ring with 2.2 GeV, 2 x 10^{33} $cm^{-2}s^{-1}$ luminosity. 8 refs., 5 figs.

45978 Reactive impedance of a smooth toroidal chamber below the resonance region. Ng, K. (Superconducting Super Collider Central Design Group, Lawrence Berkeley Laboratory, Berkeley, California 94720(US)); Warnock, R. *Physical Review [Section] D: Particles and Fields (USA),* 40(1): 231-243 (1 Jul 1989). DOE Contract AC03-76SF00515.

We evaluate the longitudinal coupling impedance of a smooth toroidal vacuum chamber in the domain of frequencies below the

first synchronous resonant mode. The chamber has rectangular cross section. With infinite wall conductivity, as assumed here, the nonresonant impedance is purely reactive. It consists of a space-charge term proportional to $1/\gamma^2$ and a curvature term which survives even when $\gamma \rightarrow \infty$. In the entire subresonant domain, the curvature term is well represented as a quadratic function of frequency: namely, $Z/n = iZ_0(h/\pi R)^2[A - 3B(\nu/\pi)^2]$, where h is the height of the chamber and R is the trajectory radius and $\nu = \omega h/c$. The constants A and B are of order 1, being nearly equal to 1 if the width of the chamber is somewhat greater than its height. Thus, $\mathrm{Im}Z/n$ from curvature is typically a very small fraction of an ohm below the resonance domain, which begins when $\nu > (R/h)^{1/2}$. Consequences for beam stability, if any, arise from high-frequency resonances which can produce values of several ohms for Z/n.

45979 Review of synchrotron beam stability and stabilizing systems. Hettel, R. (Stanford Synchrotron Radiation Laboratory, Stanford, California 94305 (US)). *Review of Scientific Instruments (USA),* 60(7): 1501-1506 (Jul 1989). DOE Contract AC03-82ER13000.

Fluctuations of the stored beam orbit, together with the vibration and thermal distortion of beamline optical components, introduce photon beam position and angle instabilities at distant experimental stations and degrade data quality for many experiments. Systems employing sensitive photon beam position monitors have been devised to reduce the magnitude of these disturbances to tolerable levels. Desired stability levels for the vertical plane, in which the beam is highly collimated, are 10 μm in position and 1 μrad in angle. Horizontal stabilizing systems are also being developed for certain undulator and horizontally focused beams that are likewise adversely influenced by small motions. An order of magnitude increase in stability requirements is expected for the next generation of very low emittance and small aperture beam sources. Achieving this stability will depend on the combined efforts of storage ring mechanical, electrical, and lattice designers as well as on the development of improved position monitoring and beamline optical systems.

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Refer also to citation(s) 44990, 45864, 45916, 46111, 46112, 46113, 46117, 46352, 46374, 46436, 46440, 46509

45980 (AD-A-207768/3/XAB) **Response functions of a BC501 scintillation detector for neutrons up to 41 MeV. Final report, March 1985-December 1987.** Kiziah, R.R.; Snell, M.P. Air Force Weapons Lab., Kirtland AFB, NM (USA). Apr 1987. 67p. (AFWL-TR-88-33). Available from NTIS, PC A04/MF A01.

Using time-of-flight and pulse-shape discrimination techniques, the response functions of a 5-cm-long by 5-cm diam BC501 liquid organic scintillation detector were measured for nearly monoenergetic neutrons at 43 energies between 2 and 41 MeV. Absolute normalization of the neutron pulse-height distributions for energies less than 31 MeV was performed by matching the largest pulse-height regions, the proton-recoil plateaus, of the distributions to Monte Carlo calculations of the detector response. The remaining distributions were normalized through comparison of experimental and calculated integral efficiencies. The 32 BC501 neutron response functions at energies between 2 and 22 MeV agree well with published response functions of a 4.60-cm-long by 4.65-cm-diam NE213 scintillation detector when simple corrections are applied for differences in density, composition, size, and normalizing cross-sectional area between the detectors. This set of BC501 response functions is to be used for construction of a detailed response matrix for unfolding neutron pulse-height distributions up to energies of 41 MeV. With simple scale adjustments, the response functions can also be used for unfolding pulse-height distributions acquired with an equal-sized NE213 scintillation detector.

45981 (AD-A-207901/0/XAB) **Instrumentation for radiological emergency responses. Memorandum report.** Klopcic, J.T. Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab. May 1989. 34p. (BRL-MR-3761). Available from NTIS, PC A03/MF A01.

This report provides an overview of the instrumentation and associated techniques that would be used to perform radiological monitoring at an accident/incident involving the release of radioactive materials. This article is not intended to serve as a user's manual for the various instruments. However, it is intended to include sufficient detail to provide an appreciation and use of such techniques in case of an emergency. For completeness, some elementary characteristics of different kinds of radiation are also included. Quantitative measurements of radioactive contamination in the field is extremely difficult. Particles having short ranges, such as alpha and low-energy beta radiation, are significantly and incalculably affected by minute amounts of dust or precipitation. Therefore, detection - rather than measurement - is a more realistic goal for alpha-beta surveys. More-penetrating radiations such as gamma and higher energy x-rays are less effected by such overburden.

45982 (AECL-9432) **Heavy water solar neutrino detector.** Earle, E.D.; Sudbury Neutrino Observatory Collaboration. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Apr 1987. 32p. (CONF-870279-: Lake Louise winter institute meeting, 15-21 Feb 1987; SNO-87-4). Order Number DE89635584/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The construction of a solar neutrino observatory utilizing 1000 tonnes of D_2O in a nickel mine near Sudbury is proposed. The rationale for such an observatory, the characteristics of the detector and its sensitivity are discussed. Recent progress in resolving some of the problems in the construction and operation of the detector are outlined. Technical measurements and engineering designs are in progress with a view to preparing detailed cost estimates. 48 refs.

45983 (BONN-IR-88-42) **Studies on the optimization of the ZEUS transition-radiation detector.** Kiehm, H. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Aug 1988. 54p. (In German). Order Number DE89915160/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

This paper describes the results of test measurements, made with pre-prototypes of the ZEUS-TRD. We used longitudinal drift chambers filled with 90% xenon and 8% CO_2/2% iso-C_4H_{10} as quench gases. The readout was made by 6bit nonlinear FADC's with an effective dynamic range of 8bits. The used amplifiers were types built in SMD-technique with high amplification factors. Pole-Zero filters to make the pulses shorter and better reconstructable were build in. The cathode wires, wires that separate the drift region from the amplification region, were also read out, and showed signal structures similar to that of the signal-wires. These cathodes, fixed perpendicular to the sense wires, are useful to identify double tracks. New radiator types, based on polypropylen fibres have been tested. We found that the coating of the fibre surfaces is very bad for the production of transition radiation. To separate hadrons from electrons we used 3 different total-charge methods; two of them preferred cluster-structures. For the test we took data on the base of one chamber and simulated 4 chambers (the final ZEUS-TRD will have 4 ones) with a liklihood-algorithm. We took the data at the CERN PS at 1-10 GeV with a mixed particle beam am. For an electron efficiency of 90% we found the following pion contaminations: minimum contamination at 4 GeV 1.7%, maximum contamination at 10 GeV 3.1%. (orig.).

45984 (BONN-IR-88-44) **Construction and test of a neutron detector for the PHOENICS experiment.** Kueckes, M. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Aug 1988. 37p. (In German). Order Number DE89915159/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A neutron detector consisting of 23 scintillation counters (20x20x100 cm^3) has been built and tested. This device is part of the PHOENICS experiment at the new Electron-Stretcher-Accelerator ELSA. A spatial resolution of 3 cm and a time resolution of 175 ps could be achieved. (orig.).

45985 (BONN-IR-88-49) **Studies on the angular and momentum resolution of the hadron spectrometer at the ELAN**

experiment. Schoenwald, D. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Sep 1988. 74p. (In German). Order Number DE89915162/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

By MC calculations with the simulation program for the hadron spectrometer the accuracy in the determination of starting momentum, starting angles, and starting position reachable with the hadron spectrometer was studied. The calculations show that the reachable accuracy is essentially constrained by two factors. These are on the one hand the multiple Coulomb scattering on the target, on the air, and on the detection elements as well as on the other hand the finite resolution of the proportional chambers. The extension of the multiple Coulomb scattering is dependent both on the momentum and on the mass of the hadron. At increasing momentum and decreasing mass decreases the influence of the multiple scattering. The influence of the multiple Coulomb scattering on the resolutions in comparison to the influence of the finite angular resolution of the proportional chambers on the resolutions varies much between the single back-calculational quantities. Approximation formulas for the resolution of the hadron spectrometer in the starting momentum, starting angles, and the starting position in dependence on the starting momentum could be stated. (orig.).

45986 (BONN-IR-88-58) **A measuring facility for the uniformization of the optical readout at the ZEUS calorimeter.** Jahnen, G. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Oct 1988. 51p. (In German). Order Number DE89915161/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The ZEUS-detector for HERA features a high resolution calorimeter of the sampling type. The passive layers are made of depleted uranium and the active layers are of aromatic scintillator. The layer thicknesses are chosen to yield full compensation, i.e. for a given energy electrons or photons produce the same signal as hadrons or jets. The scintillators are read out via wave length shifter bars. A uniform response of the wave length shifter i.e. a response independent of the entrance position of the scintillator light, is essential to obtain best possible resolution. This diploma thesis concentrates on the apparatus and the procedure to produce wave length shifters for the electromagnetic sections of the ZEUS forward calorimeter to better than +-2%. (orig.).

45987 (EUR-11755, pp. 125-139) **Pips-technology for α,β and γ measurements.** Burger, P.; Schoenmaekers, W. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146--: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The paper reviews the basic properties of nuclear detectors and gives a short description of the major available detector types. It subsequently discusses Passivated Implanted Planar Silicon technology and its applications in nuclear metrology.

45988 (EUR-11755, pp. 140-155) **Metrology of radioactive aerosols with automatic self-checking monitors.** Frenzel, E. (Erlangen-Nuernberg Univ., Erlangen (DE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146--: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The paper gives a technical description of an aerosol monitor for determining low concentrations of artificial radioactive aerosols in the atmosphere. The principle of measurement consists of determining the natural beta aerosol radioactivity concentration and subtracting it from the gross beta radioactivity concentration, based on a simultaneous alpha and beta measurement. The performance of the monitor is demonstrated with laboratory experiments and experiences related to the Chernobyl accident. The paper also describes further developments in the field using modern nuclear detectors.

45989 (FNAL/C-89/155-E) **New tools for the simulation and design of calorimeters.** Womersley, W.J. Fermi National Accelerator Lab., Batavia, IL (USA). 10 Jul 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8905194-3: 4. Pisa meeting on advanced detectors: frontier detectors from frontier physics, 21-26 May 1989). Order Number DE89016323/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Two new approaches to the simulation and design of large hermetic calorimeters are presented. Firstly, the Shower Library scheme used in the fast generation of showers in the Monte Carlo of the calorimeter for the D-Zero experiment at the Fermilab Tevatron is described. Secondly, a tool for the design future calorimeters is described, which can be integrated with a computer aided design system to give engineering designers an immediate idea of the relative physics capabilities of different geometries. 9 refs., 6 figs., 1 tab.

45990 (FNAL-TM-1602) **Technical memo on PbF_2 as a Cherenkov radiator for EM calorimetry.** Anderson, D.F. Fermi National Accelerator Lab., Batavia, IL (USA). 26 Jun 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89014014/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It is apparent that the ever increasing rates and radiation levels found in high-energy physics are excluding more and more instrumental techniques. Those techniques that are remaining are often pushed to their theoretical limits. This situation reaches an extreme at the proposed luminosity of the SSC. Also, it is fair to say that at the SSC, after the accelerator itself, calorimetry will be the next most important physics tool. Therefore, we should be ever alert to new calorimetry techniques which may operate in this demanding environment. The material lead fluoride, PbF_2, has a real potential of yielding a very compact, high-resolution electromagnetic calorimeter that is both fast and radiation hard. PbF_2 is not a scintillator but a Cherenkov radiator like lead glass, but with a radiation length even harder shorter than of BGO. This memo discusses this property as well as comparison PbF_2 to other scintillating materials. 2 refs., 14 figs., 1 tab.

45991 (FNAL-TM-1604) **Performance of the CAMEX64 silicon strip readout chip.** Yarema, R.J. Fermi National Accelerator Lab., Batavia, IL (USA). Jun 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89014015/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

The CAMEX64 is a 64 channel full custom CMOS chip designed specifically for the readout of silicon strip detectors. CAMEX which stands for CMOS Multichannel Analog MultiplEXer for Silicon Strip Detectors was designed by members of the Franhofer Institute for Microelectronic Circuits and Systems and the Max Planck Institute for Physics and Astrophysics. Each CAMEX channel has a switched capacitor charge sensitive amplifier with 4 sampling capacitors and a multiplexing scheme for reading out each of the channels on an analog bus. The device uses multiple sampling capacitors to filter and reduce input noise. Filtering is controlled through sampling techniques using external clocks. The device operates in a double correlated sampling mode and therefore cannot separate detector leakage current from a charge input. Normal operation of this device is similar to all other silicon readout chips designed and built thus far in that there is a data acquisition cycle during which charge is simultaneously accepted on all channels for a short period of time from a detector array, followed by a readout cycle where that charge or hit information is read out. This device works especially well for colliding beam experiments where the time of charge arrival is accurately known. However it can be used in fixed target or asynchronous mode where the time of charge arrival is not well known. In the asynchronous mode it appears that gain is somewhat dependent on the time interval required to decide whether or not to accept charge input information and thus the maximum signal to noise performance found with the synchronous mode may not be achieved in the asynchronous mode. 18 figs., 5 tabs.

45992 (FNAL-TM-1610) **Radiation measurements inside the CDF detector.** Yarema, R.J. Fermi National Accelerator Lab., Batavia, IL (USA). 20 Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. Order Number DE89016016/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

During the last CDF experimental period from 6/88 to 6/1/89, radiation measurements were made inside the detector on or near the beampipe using various types of monitors. The purpose of the tests was to help predict the radiation levels for future electronics which must be located close to the interaction area. The results from two different types of monitors, PIN diodes and TLD's are reported in this paper. The TLD's (Harshaw/Filtrol type 700) are sensitive to x-rays, gammas, alphas, electrons, and protons. They are calibrated against a cesium source and corrected for nonlinear effects at higher radiation levels. The PIN diodes (Harshaw/Filtrol type DN-156) are sensitive only to neutrons. The devices are calibrated for 1 MeV neutrons and require correction factors for neutrons at other energy levels. All of the monitors were placed just outside of the VTPC, but still inside the CDF magnetic field. The monitors were located 68 inches from the center of the interaction region. The beam pipe is 2 inches in diameter. Therefore the closest monitoring points were on the beampipe or 1 inch from the beam. 5 figs., 2 tabs.

45993 (GSI–89-12) **Optimization and extension of the GSI double-orange apparature for the study of e^+e^- pairs emitted in heavy ion collisions.** Schroeter, A. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Technische Univ. Muenchen, Garching (Germany, F.R.). Fakultaet fuer Physik. May 1989. 116p. (In German). Order Number DE89915119/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

In order to study the mapping properties and detection probabilities of the double-orange apparature of the GSI for e^+e^- pairs from different pair production processes (two-body decay, IPC) detailed Monte-Carlo simulation calculations were performed. On the base of the results produced thereby a comprehensive extension of the apparature was performed in which among others a new heavy-ion detector system was added and the energy resolution, the counting-rate capacity, and the spatial acceptance angle of the lepton detectors were essentially improved. With the optimized apparature the collisional systems U+U and U+Pb were studied, whereby four times higher positron and e^+e^- coincidence detection rates than in comparable experiments with the old facility were reached. (orig.).

45994 (GSI–89-13) **Production, transport and charge capture measurements of highly charged recoil ions.** Trebus, U.E. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Texas A and M Univ., College Station, TX (USA). May 1989. 138p. Order Number DE89915120/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

An experiment is described to study highly charged recoil ions on-line to the heavy ion accelerator UNILAC at GSI. The highly charged recoil ions are produced by heavy ion bombardment of a gas target. Subsequently the slow highly charged recoil ions are extracted from the ionization volume, and guided through a beam transport line to a Wien filter for charge state selection and to a collision region to study charge transfer processes. Several experiments were carried out to show the efficient charge state separation. Charge states up to q=15 were observed. When using a retarding field analyzer cross sections for single electron capture were determined for different charge states of Xe^{q+} for q=4 to 11 and He gas. The experiments demonstrated increasing charge transfer cross sections with increasing charge state q and indicated the effect of near resonant charge capture for q=6. The flexible data acquisition system used, is described and other future experiments, such as for instance in flight ion-trapping are indicated in the appendix. (orig.).

45995 (INIS-BR–1561) **Vacuum ultraviolet spectroscopy of some hydrocarbons by electron impact technique.** Azevedo e Souza, A.C. de. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). Jul 1985. 166p. (In Portuguese). Order Number DE89636479/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

A detailed description of the construction and operation of the electron impact spectrometer of the Electron Impact Laboratory at the Chemistry Institute of Federal University of Rio de Janeiro are presented. The main characteristics of this spectrometer are: incident energy from 0.5 to 3.0 KeV; angular range from -60^0 to $+ 60^0$; energy loss from 0 to 500 eV; energy resolution from 0.5 to 2.5 eV and; electron velocity analyser equal to electrostatic (Mollenstedt) type. The data acquisition system is based on a microcomputer Motorola; recently an APPLE II system has been incorporated to the spectrometer. Electron energy loss spectra for the nitrogen molecule as well as for some hydrocarbons (C_2H_6, C_2H_4, C_2H_2) have been obtained. The data were converted into double differential cross sections and generalized oscillator strenghts. (author).

45996 (INIS-BR–1599) **Development of nuclear magnetic resonance tomography technology - TORM.** Tannus, A. Sao Paulo Univ., Sao Carlos, SP (Brazil). Inst. de Fisica e Quimica. 1987. 228p. (In Portuguese). Order Number DE89636485/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The development of hardware and software necessary to implement the Magnetic Resonance Imaging (MRI) techniques is described. The major subjects were the construction of an aquisition and control system which allowed the operation of a pulsed Fourier NMR spectrometer as a NMR Tomograph; further it was oriented the developing of a NMR spectrometer whose parameters could be easily reconfigured by the controlling system. As a result a sofisticated equipment which allows, more than the proposed, working with high resolution spectroscopic techniques and spectroscopy in solids, was obtained. Since the basic techniques employed in NMR and CT Tomographs are well known, a great emphasis was also given on the understanding of the image reconstruction techniques that constitutes today the frontier of research in this area. The results obtained with the system described here are considered good, comparable to the results from commercial units developed in cooperation with imaging groups located in universities abroad. (author).

45997 (INIS-BR–1603) **Multiwire proportional chamber for Moessbauer spectroscopy: development and results.** Costa, M.S. da. Universidade Federal, Rio de Janeiro, RJ (Brazil). Inst. de Fisica. Dec 1985. 99p. (In Portuguese). Order Number DE89636480/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

A new Multiwere proportional Chamber designed for Moessbauer Spectroscopy is presented. This detector allows transmission backscattering experiments using either photons or electrons. The Moessbauer data acquisition system, partially developed for this work is described. A simple method for determining the frontier between true proportional and semi-proportional regions of operation in gaseous detectors is proposed. The study of the tertiary gas mixture He-Ar-CH_4 leads to a straight forward way of energy calibration of the electron spectra. Moessbauer spectra using Fe-57 source are presented. In particular those obtained with backsattered electrons show the feasibility of depth selective analysis with gaseous proportional counters. (author).

45998 (INIS-SU–100, pp. 24-28) **Precision measurements of the conversion lines intensities by a modernized β-spectrometer UMB-1.** Davidonis, R.J.; Zhirgulevichius, R.K.; Kalinauskas, R. and others. AN Litovskoj SSR, Vilnyus (USSR). Inst. Fiziki; AN SSSR, Moscow (USSR). Nauchnyj Sovet po Yadernoj Spektroskopii. 1988. (In Russian). (CONF-8805315–: 7. seminar on precise measurements in nuclear spectroscopy, 26-27 May 1988). In *Problems of precision in nuclear spectroscopy. Collection of materials.* Order Number DE89012201/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The UMB-1 beta-spectrometer measurements are performed using a 20-band source and a 16-channel microchannel plate electron detector. To control the spectrometer and to store, process and output information an automated device based on DVK-2 and CAMAC-crate interactive computer complex with appropriate functional modules is developed. Brief performances of the device and the possibilities of control and initial result processing programs are presented. The examples of measuring ^{109}Cd ICE spectra with 0.04-0.05% resolution with the statistic precision, of determining the intensity of conversion lines of about 1%, are given. The measurement of ICC relations with different theoretical relations is compared. 11 refs.; 2 figs.; 1 tab.

45999 (IPEN-PUB–243) **Least square methods and covariance matrix applied to the relative efficiency calibration of a Ge(LI) detector.** Geraldo, L.P.; Smith, D.L. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 32p. Order Number DE89636486/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The methodology of covariance matrix and square methods have been applied in the relative efficiency calibration for a Ge(Li) detector apllied in the relative efficiency calibration for a Ge(Li) detector. Procedures employed to generate, manipulate and test covariance matrices which serve to properly represent uncertainties of experimental data are discussed. Calibration data fitting using least square methods has been performed for a particular experimental data set. (author).

46000 (KEK–88-10, pp. 322-329) **Results from VENUS.** Yamada, Yoshikazu (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The VENUS detector is a general purpose magnetic detector. The central drift chamber is placed in magnetic filed of 7.5 kG and has a coverage of 30deg$\leq\theta\leq$150deg with momentum resolution of σ_p/P = 0.008 P_t (GeV/c). The barrel lead glass calorimeter has a coverage of 37deg$\leq\theta\leq$143deg with energy resolution of σ_E/E = 3.7% for electrons of 26GeV. The end cap liquid argon calorimeter has a coverage of 8deg$\leq\theta\leq$38deg and 142deg$\leq\theta\leq$172deg with resolution of σ_E/E = 3.5% for electrons of 26GeV. The TOF counter system has a coverage of 35deg$\leq\theta\leq$145deg with time resolution of 220 psec. The barrel part of muon chamber has a coverage of 62% of 4π. VENUS has accumulated data of 11 pb^{-1} between $\sqrt{s}$ = 50GeV and = 56GeV. The lower-limits of the QED cutoff parameters for e^+e^-->e^+e^- and $\gamma\gamma$ were obtained as 164GeV(Λ_+), 218GeV(Λ_-) and 80GeV(Λ_+), 76GeV(Λ_-), respectively. The forward-backward charge symmetries for μ-pair and μ-pair production were obtained as -0.32+-0.07 and -0.20+-0.11, all of which agree well with theoretical predictions. The production of the sequential heavy lepton was excluded for $m_L\leq$27.5GeV/c^2 both for stable and unstable case. The measured R ratio R = 4.78+-0.22+-0.21 at $\sqrt{s}$ = 56GeV was consistent with the prediciton of the standard model with 5 flavors. The shape analysis of the hadronic events excluded the production of the open top quark. No anomaly was found in the hadronic events with isolated leptons in low thrust region. (N.K.).

46001 (N–89-23399) **Observational techniques for solar flare gamma-rays, hard X-rays, and neutrons. Final report, 1 November 1983-30 November 1988.** Lin, R.P. California Univ., Berkeley, CA (USA). Apr 1989. 62p. (NASA-CR–184910;NAS–1.26:184910). Available from NTIS, PC A04/MF A01.

The development of new instrumentation and techniques for solar hard X-ray, gamma ray and neutron observations from spacecraft and/or balloon-borne platforms is examined. The principal accomplishments are: (1) the development of a two segment germanium detector which is near ideal for solar hard X-ray and gamma ray spectroscopy; (2) the development of long duration balloon flight techniques and associated instrumentation; and (3) the development of innovative new position sensitive detectors for hard X-ray and gamma rays.

46002 (NUREG/CP–0098-Vol.2, pp. 1099-1108) **Newly designed anticoincidence proportional counter for measuring ^{85}Kr in environmental air samples.** Jiunn-Guang, Lo (National Tsing Hua Univ., Taiwan (China)); Huanshu, Lin. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

An anticoincidence proportional counter has been developed for measuring low level ^{85}Kr in environmental air samples. The minimum detection activity is 5.2 pCi and the counting efficiency is 5.78% based on the 687 keV β energy of ^{85}Kr. A portable sampling system is also set up for the collection, separation and purification of ^{85}Kr from air samples. The mean recovery yield of this system is 91.6%. The lower limit of detection of this counting system including sampling is 9.6 pCi m^{-3}. This improved system is very suitable for monitoring ultra-low level ^{85}Kr in environmental air samples taken from a transistor factory, where ^{85}Kr is used for quality control of products. A computer program of an atmospheric diffusion model is also provided to estimate the distribution of ^{85}Kr concentration in air of the transistor factory. The highest ^{85}Kr concentration is estimated to be ~100 pCi m^{-3}.

46003 (SLAC-PUB–5002) **A review of 4π Čerenkov ring imaging detectors.** Leith, D.W.G.S. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8904267–2: Symposium on particle identification at high luminosity hadron colliders, 5-7 Apr 1989). Order Number DE89015630/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The design choices for 4π ring imaging Čerenkov counters – both those of principle and those of practice – are reviewed. The progress in construction and the performance of the devices being built for DELPHI and SLD are discussed. 13 refs., 22 figs.

46004 (SLAC-PUB–5016) **Survey of the response of standard limited streamer tubes over the complete range of three-component gas mixtures of isobutane, CO_2, argon.** Calcaterra, A.; De Sangro, R.; De Simone, P.; Burrows, P.; Cartwright, S.L.; Gonzalez, S.; Lath, A.; Schneekloth, U.; Williams, D.C.; Yamartino, J.M. SLD-WIC Collaboration. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515;AC02-76ER03069;AC02-76ER00881. (CONF-8905194–4: 4. Pisa meeting on advanced detectors: frontier detectors from frontier physics, 21-26 May 1989). Order Number DE89016692/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We present the results of a systematic study of three-component gas mixtures containing argon, isobutane, and carbon dioxide. The study used production-type chambers from the SLD Warm Iron Calorimeter (WIC), instrumented with standard pleastic streamert tubes, and triggered by cosmic-ray muons. Pulse height spectra are presented as a function of high voltage, over a wide range of mixtures of these three gases. Various features and similarities observed throughout this three-dimensional mixture space are important clues to understanding the underlying physics of discharge mechanisms in wire detectors. 15 refs., 17 figs.

46005 (SLAC-PUB–5040) **Design considerations for a Čerenkov ring imaging detector at the tau-charm factory.** Ratcliff, B.N. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–10: Tau-Charm workshop, 23-27 May 1989). Order Number DE89016945/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A schematic design of a Čerenkov ring imaging detector for use at a τ-charm factory is described. The performance of this device and its implications for the other parts of the spectrometer are discussed. 11 refs., 4 figs.

46006 (SLAC-PUB–5042) **Data acquisition and online processing requirements for experimentation at the Superconducting Super Collider.** Lankford, A.J.; Barsotti, E.; Gaines, I. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905194–5: 4. Pisa meeting on advanced detectors: frontier detectors from frontier physics, 21-26 May 1989). Order Number DE89016946/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Differences in scale between data acquisition and online processing requirements for detectors at the Superconducting Super Collider and systems for existing large detectors will require new architectures and technological advances in these systems. Emerging technologies will be employed for data transfer, processing, and recording. 9 refs., 3 figs.

46007 Fast neutron detection using a new pulse shape discrimination technique: Charge sensitive integration. Zucker, M. (Brookhaven National Lab., Upton, NY (USA)); Tsoupas, N.; Karwowski, H.; Castaneda, C.; Nimnual, S.; Porter, R.; Ward, T. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809278–: American Chemical

Society Division of Nuclear Chemistry and Technology, 25-30 Sep 1988).

A new electronic technique that depends on charge sensitive integration (CSI) has been developed and tested using a CAMAC based pulse shape discrimination system. Neutrons are well separated from γ-ray signals in the 0.1-100 MeV energy range. The new method was compared with the old zero-crossing time-to-amplitude differentiating technique and was found to be comparable in count rate and superior in noise suppression.

46008 Theoretical studies of hadronic calorimetry for high luminosity, high energy colliders. Brau, J.E. (Oregon Univ., Eugene (USA)); Gabriel, T.A. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(1/2): 40-56 (1 Jul 1989). (CONF-8806235–: International conference on advanced technology and particle physics, 12-17 Jun 1988).

Experiments at the high luminosity, high energy colliders of the future will require optimization of the state of the art of calorimetry design and construction. During the past few years, the understanding of the basic phenomenology of hadron calorimeters has advanced through parallel theoretical and experimental investigations. The important underlying processes are reviewed to set the framework for the presentation of recent calculations of the expected performance of silicon detector based hadron calorimeters. Such devices employing uranium are expected to achieve the compensation condition (that is, e/h$\simeq$1.0) based on the understanding that has been derived from the uranium-liquid argon and uranium-plastic scintillator systems. In fact, even lead-silicon calorimeters are found to achieve the attractive value for the e/h ratio of 1.16 at 10 GeV. (orig.).

46009 The zero-degree calorimeter for the relativistic heavy-ion experiment WA80 at CERN. Young, G.R. (Oak Ridge National Lab., TN (USA)); Awes, T.C.; Baktash, C.; Cumby, R.P.; Ferguson, R.L.; Gabriel, T.A.; Johnson, J.W.; Lee, I.Y.; Obenshain, F.E.; Plasil, F. *Nuclear Instruments and Methods in Physics Research, Section A: Accelerators, Spectrometers, Detectors, and Associated Equipment (Netherlands),* 279(3): 503-517 (15 Jul 1989). DOE Contract AC05-84OR21400.

Calibration and performance results are presented for a sampling calorimeter designed for use as a beam calorimeter at zero degrees in the relativistic heavy-ion experiment WA80 at CERN. This uranium-scintillator zero-degree calorimeter (ZDC) was found to have a linear response to heavy ions over the range 60-6400 GeV and an in-beam hadronic resolution ranging from $\sigma/E = 0.013+0.33/\sqrt{E}$ at low intensities to $\sigma/E = 0.02+0.67/\sqrt{E}$ at higher intensities. The e/h ratio of the electromagnetic section was measured to be 1.12 at 135 GeV. The ZDC operated reliably with incident beams of 3.2 TeV oxygen and 6.4 TeV sulfur at intensities of over 10^6 nuclei per spill. It provided a trigger both for minimum bias events and for violent central collisions. (orig.).

4402 Radiation Effects On Instrument Components, Instruments, Or Electronic Systems

Refer also to citation(s) 45553, 45871

4403 Miscellaneous Instruments

Refer also to citation(s) 44503, 44617, 44734, 45752, 45766, 45767, 45768, 45836, 45878, 45885, 45887, 46040, 46200, 46380

46010 (CONF-890736–64) **3-D heat transfer computer calculations of the performance of the IAEA's air-bath calorimeters.** Elias, E.; Kaizermann, S.; Perry, R.B.; Fiarman, S. Argonne National Lab., IL (USA). 1989. 6p. Sponsored by U.S. DOE Radioactive Waste Management. DOE Contract W-31109-ENG-38. From 30. annual meeting of the Institute of Nuclear Materials Management; 9-12 Jul 1989. Order Number DE89016908/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A three dimensional (3-D) heat transfer computer code was developed to study and optimize the design parameters and to better understand the performance characteristics of the IAEA's air-bath calorimeters. The computer model accounts for heat conduction and radiation in the complex materials of the calorimeter and for heat convection and radiation at its outer surface. The temperature servo controller is modelled as an integral part of the heat balance equations in the system. The model predictions will be validated against test data using the ANL bulk calorimeter. 11 refs., 6 figs.

46011 (CONF-890902–7) **Real-time observations of aerosol composition changes.** Johnson, S.A.; Kumar, R. Argonne National Lab., IL (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From 198. American Chemical Society national meeting; 10-15 Sep 1989. Order Number DE89012382/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed a near real-time aerosol particle analyzer that uses a combination of filtration and impaction for particle size classification and collection, and Fourier-transform infrared (FTIR) spectroscopy for analysis. This infrared aerosol analyzer (IAA) supplies full range (2.0–20 μm) infrared absorption spectra of the ambient aerosol separated into three different size fractions. The coarse size fraction, >2.5 μm aerodynamic diameter (a.d.), made up largely of crustal matter, is analyzed separately from the fine (0.5–2.5 μm a.d.) and the ultra-fine (<0.5 μm a.d.) size fractions which contain the secondary particulate matter that is formed in the atmosphere from gaseous and condensed-phase precursors. Separating the three size fractions avoids interactions between the possibly acidic fine fractions and the possibly basic coarse fraction. The collected particulate samples are analyzed in situ by infrared spectroscopy with analytical time resolutions approaching those of trace gas analyzers. 5 refs., 8 figs.

46012 (CONF-890996–2) **Using self-calibrating thermocouples in industry.** Ruppel, F.R. Oak Ridge National Lab., TN (USA). 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Sensor's expo '89; 12-14 Sep 1989. Order Number DE89013539/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The self-calibrating thermocouple is a thermocouple with a low melting point, high-purity metal encapsulated near but metallurgically isolated from its thermojunction. It is designed to provide a single-point calibration of the thermocouple at the melting point of the encapsulated metal because the time-temperature curve of the thermocouple will plateau at this temperature during heating or cooling. The calibration procedure consists of comparing the plateau temperature with the known melting point temperature of the encapsulated metal. The difference between these two values is the thermocouple error at the calibration point. The device is commercially available, but to be effective in industry it must be augmented with a data acquisition system with an algorithm that will automatically report the calibration error. 5 refs., 7 figs.

46013 (CONF-890996–4) **Optical pyrometer temperature measurement in metal-casting operations.** Lind, R.F.; Mee, D.K. Oak Ridge National Lab., TN (USA). 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Sensor's expo '89; 12-14 Sep 1989. Order Number DE89014754/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Oak Ridge Y-12 Plant in Oak Ridge, Tennessee, produces a variety of weapons-related components for the US Department of Defense. In recent years the Y-12 Plant has been undergoing renovations and process improvements as part of an overall modernization effort. Part of this work includes the automation of temperature control in a number of metal-casting operations. This paper relates the experience of implementing an automatic temperature measurement system for the metal casters, especially the two-color optical pyrometers eventually selected as the primary temperature sensor. 2 refs., 2 figs., 1 tab.

46014 Sub-nanosecond, photon counting, imaging, x-ray camera. Whelan, D.A. (Lawrence Livermore National Lab., CA (USA)); Carter, M.R.; Price, D.F.; Steward, R.E. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A high temporal bandwidth x-ray detector has been developed for time resolved one dimensional x-ray imaging experiments. The detector serves as a high gain, high quantum efficiency preamplifier for a streak camera, and consists of a reflective x-ray photocathode, an active microchannel plate, optional electrostatic optics, and a sub-nanosecond phosphor. The optional electrostatic optics allows the detector to be used for either two dimensional imaging with a 100 picosecond framing (without focusing optics), or as a high gain one dimensional imaging detector, with either a 100 picosecond gated Reticon camera, or a streak camera. Other versions of the one dimensional detector have been developed, in which the microchannel plate which employs a reflective photocathode on the front surface of the microchannel plate, is replaced with a transmission photocathode consisting of a photocathode deposited on a thin polypropylene foil. The detector exhibits a time resolution of 400 picoseconds FWHM, a spatial resolution of 350 μm with an electron compression of ten to one (100μm resolution without compression). Quantum efficiency of 40% have been achieved, and 100% have been achieved with the one dimensional electrostatic optics. Data will be presented on the efficiency, time response and spatial resolution of the one dimensional detectors. 4 refs., 9 figs.

46015 (DOE/ER/40319–T1) **Fiber tower calorimeter continuation proposal and status report.** Walker, J.K.; White, A.P.; Wahl, H. Florida State Univ., Tallahassee, FL (USA). 1989. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-87ER40319. Order Number DE89016661/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

In November 1988 our "Proposal to Build a New High Resolution Fiber Tower Calorimeter" was approved by DOE/SSC Division. The present document is a continuation proposal and status report for the FSU portion of this project.

46016 (EGG–10617-6055) **Fiber optics: A brief introduction.** Gruchalla, M.E. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1989. 14p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC08-88NV10617. (CONF-890996–1: Sensor's expo '89, 12-14 Sep 1989). Order Number DE89009337/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

A basic introduction into the principles of fiber optics is presented. A review of both the underlying physical principles and the individual elements of typical fiber-optic systems are presented. The optical phenomenon of total internal reflection is reviewed. The basic construction of the optical fiber is presented. Both step-index and graded-index fiber designs are reviewed. Multimode and single-mode fiber constructions are considered and typical performance parameters given. Typical optical-fiber bandwidth and loss characteristics are compared to various common coaxial cables, waveguides, and air transmission. The constructions of optical-fiber cables are reviewed. Both loose-tube and tightly-buffered designs are considered. Several optical connection approaches are presented. Photographs of several representative optical connectors are included. Light Emitting Diode and Laser Diode emitters for fiber-optic applications are reviewed, and some advantages and shortcomings of each are considered. The phenomenon of modal noise is briefly explained. Both PIN and Avalanche photodetectors are reviewed and their performance parameters compared. Methods of data transmission over optical fiber are introduced. Principles of Wavelength, Frequency, and Time Division Multiplexing are briefly presented. The technology of fiber-optic sensors is briefly reviewed with basic principles introduced. The performance of a fiber-optic strain sensor is included as a practical example. 7 refs., 10 figs.

46017 (EGG-M–14487) **Proposed recoil mass spectrometer for heavy ion reactions.** Cole, J.D.; Cormier, T.M.; Hamilton, J.H.; Ramayya, A.V. EG and G Idaho, Inc., Idaho Falls, ID (USA). 1987. 5p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570;AS05-76ER05034. (CONF-870970–19: 5. international conference on nuclei far from stability, 14-19 Sep 1987). Order Number DE89010981/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A proposed recoil mass spectrometer of high rigidity, large solid angle acceptance, and good mass resolution for use with the HHIRF accelerators at ORNL is described. 5 refs., 3 figs., 1 tab.

46018 (Juel–2254) **Examination of the suitability of noise thermometry for precise in situ calibration of thermocouples in technical processes. Verification of the achievable accuracy at fixed points.** Fechner, H. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Zentrallabor fuer Elektronik; Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung; Technische Hochschule Aachen (Germany, F.R.). Dec 1988. 197p. (In German). Order Number DE89914976/JAW. Available from NTIS (US Sales Only), PC A09/MF A01.

The aim was to determine the achievable accuracy of the noise thermometer developed at the KFA in the range from 0 to 1000^{0}C under laboratory conditions. Precision noise temperature measurements at fixed temperature points (triple point of water, freezing point of zinc and silver) were carried out. The fixed point technique and the conventional precision resistance thermometry, which is required to operate the fixed points, were established in accordance with the requirements of accurate (and thus longer lasting) noise temperature measurements. The analysis of all possible sources of error ensured that all systematic or random errors were in the range of a few 10^{-5}. The further developed KFA noise thermometers, which can be used under industrial conditions, achieve under laboratory conditions a measuring error of about +-2.5 10^{-4} - relative to the thermodynamic temperature scale - in the temperature range from 273.16 K (0.01^{0}C) to 1234.894 K (961.744^{0}C). Assuming that the individual measured values display a normal distribution, the noise measurements at the zinc and silver point are combined to a mean value, it becomes apparent that the average noise temperatures only deviate by +2 10^{-5} (zinc) or +4 10^{-5} (silver) from the respective thermodynamic temperature. (orig./HP).

46019 (LA-UR–89-2112) **Multimode fiber interferometry and several-mode fiber polarimetry via phase conjugation.** Forman, P.R.; Jahoda, F.C.; Mason, B.L.; Netterfield, C.B. Los Alamos National Lab., NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8909161–1: 6. international conference on optical fiber sensors, 17-20 Sep 1989). Order Number DE89014226/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

While the simplest fiber optics are realized by transmission intensity modulations impressed on multimode fibers, great enhancements in sensitivity are achieved by interferometric or polarimetric methods with light propagated through single-mode fibers. In this paper we report preliminary experiments on retaining the sensitivity of interferometric and/or polarimetric measurements while using only multimode fiber components. The utility of success in this endeavor can be measured by greater experimental simplicity (light injection and alignment tolerances), by cost factors (cheaper fiber optics components), or by larger intensity transmission limits (which can be translated to higher time resolution for a given signal-to-noise ratio). 14 refs., 3 figs.

46020 (LBL–26734) **Atomic imaging and interfacial analysis.** Hetherington, C.J.D.; Thomas, G. Lawrence Berkeley Lab., CA (USA). Jan 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8901153–1: Ceramics-metal interfaces conference, 16-18 Jan 1989). Order Number DE89015339/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The structure and composition of interfaces are important in influencing the overall physical properties of materials. Thus, a methodical development of the growth and processing of metal/ceramic composites with a view to improving their properties should be accompanied by a characterization of the interfacial structures. In this paper, the contribution of atomic imaging by electron microscopy to such an analysis is indicated with examples of research utilizing the Atomic Resolution Microscope (ARM) at the National Center for Electron Microscopy. 10 refs., 1 fig.

46021 (NRC–27703) **The Pt/Au thermocouple.** MacLaren, E.H.; Murdock, E.G. National Research Council of Canada, Ottawa, ON (Canada). 1987. 117p. (MICROLOG–89-03296). Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In the first part of this study the essential thermoelectric performance, following a recommended preparatory heat treatment, of the Pt/Au thermocouple was examined at the ice point and at the freezing and melting temperatures of high purity metals. Direct comparisons at high precision of the immersion thermoelectromotive force characteristics of the Pt/Au and Pt/Pt10Rh thermocouples at the metal fixed points are presented and critical assessments of the merits of these thermocouples for temperature measurements in the 0-1000^{0}C range are drawn. The stress-relieved Pt/Au couple clearly outclasses the Pt/Pt10Rh couple in thermoelectric stability, homogeneity and sensitivity and even challenges the high temperature platinuim resistance thermometer on the basis of simplicity and economic practicality. The Pt/Au couple, therefore, merits serious consideration as an alternative but preferred temperature sensor for many, if not most, precise (+- 0.0^{0}C) temperature measurements in the 0-1000^{0}C range. The second part of the study describes the investigations on the effects of heat treatments at 450-1000^0 C on the thermoelectric stability and homogeneity of high purity Au wire that led to the preferred preparatory anneal which underlies the superior performance of Pt/Au thermocouples as described in the first part. Comparisons of the thermoelectric effects of up to 100 h heat treatments at uniform temperatures on wires from a single refined batch, from different batches from a single refiner, and from batches produced by different refiners are presented. An overview is given of the variations that may be expected in selecting wire for Pt/Au thermocouples. 47 refs., 30 figs., 9 tabs.

46022 (NRC–29808) **Fuel flow measurement in gas turbine testing.** Garbe, W. National Research Council of Canada, Ottawa, ON (Canada). 1988. 54p. (MICROLOG–89-03256). Available from National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The accurate measurement of fuel flow constitutes an important part of gas turbine performance assessment. Prompted by an international turbine performance evaluation, the Engine Laboratory of the National Research Council of Canada has critically examined the existing fuel flow measuring methods. The report describes documentation wherever possible. Since the laboratory employs turbine flowmeters exclusively, the discourse has been limited to that type offlow establishment. Together with an in-house ballistic flowmeter system, the present Engine Laboratory fuel flow measuring system provides gas turbine fuel flow assessment of known accuracy. An error analysis, for normal operating conditions, indicated an uncertainty in corrected fuel flow of +_0.75%. Recommendations have been made for improvements in some measurement components. 16 refs., 8 figs., 1 tab.

46023 (OH/RD–88-41-K) **Evaluation of the environmental instruments wind and temperature probe in a wind tunnel and environmental chamber.** Tam, Y.T. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 20p. (MICROLOG–89-02612). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The operational usefulness of a recently acquired wind, temperature and relative humidi ty probe was investigated in a wind tunnel facility, and an environmental chamber at Ontario Hydro Research Division. Results from the tests indicate that the probe generally performs satisfactorily. However, the wind speed response is slightly low when the wind is from 360 degrees. A slight underestimation is also observed when the wind is from 225 degrees and below about 8 m/s. This under-estimation is thought to be attributable to the configuration of the probe itself. Temperature and relative humidity measurements made with the probe agreed very well with experimentally set values. 4 figs., 12 tabs.

46024 (UCRL–100242) **Maximization of directed electromagnetic radiation with an optimized antenna.** Bevensee, R.M. Lawrence Livermore National Lab., CA (USA). Jun 1989. 5p. Sponsored by U.S. Department of Defense. DOE Contract W-7405-ENG-48. (CONF-8908101–1: International Union of Radio Science international symposium on electromagnetic theory, 14-17 Aug 1989). Order Number DE89014045/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We summarize the results of a study to obtain reasonable upperbounds to the maximum energy density $W_T(\Omega_0)$ per steradian radiated during a time interval $(-T,T)$ in a direction Ω_0 and also the maximum instantaneous far-field $|rE(\Omega_0)|$. The constraints are (1) the antenna elements are driven in series by a circuit of zero stored energy around a simple series resonance, (2) the antenna is enclosed within a spherical working volume of radius $a/\lambda_{min} = 1$, (3) signal frequencies are restricted to $\omega \leq \omega_{max} = 2\pi c/\lambda_{min}$, (4) the total energy radiated is 1 J. 6 refs., 3 figs.

46025 Torsional piezoelectric crystal viscometer for compressed gases and liquids. Diller, D.E. (National Institute of Standards and Technology, Boulder, CO (USA)); Frederick, N.V. *International Journal of Thermophysics (USA),* 10(1): 145-157 (Jan 1989). (CONF-880606–: 10. symposium on thermophysical properties, 20-23 Jun 1988).

A torsional piezoelectric crystal viscometer for compressed gases and liquids at temperatures to 600 K and a pressures to 70 MPa has been developed. Several torsional crystals were prepared from swept (electrolyzed) quartz to obtain a good performance at high temperatures. Measurements of the bandwidth of the crystal resonance curve were automated using an impedance analyzer. The viscometer was tested on compressed gaseous argon and methane at temperatures to 500 K and at pressures to 50 MPa. The measurements differ from accurate wide-range correlating equations by less than 2%.

46026 Container for heat treating materials in microwave ovens. Holcombe, C.E.; Dykes, N.L.; Kimrey, H.D. Jr.; Mills, J.E. To Dept. of Energy, Washington, DC. USA Patent 4,810,846. 7 Mar 1989. Filed date 26 Jan 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

The efficiency of a microwave oven of a conventional two-source configuration and energy level is increased by providing the oven with a container for housing a refractory material to be treated. The container is formed of top and bottom walls transparent to microwaves while the sidewalls, in a circular configuration, are formed of a nonmetallic material opaque to microwave radiation reflecting the radiation penetrating the top and bottom walls radially inwardly into the center of the container wherein a casket of heat-insulating material is provided for housing the material to be heat treated. The reflection of the microwave radiation from the sidewalls increases the concentration of the microwaves upon the material being heat treated while the casket retains the heat to permit the heating of the material to a substantially higher temperature than achieveable in the oven without the container.

4404 Well Logging Instrumentation

Refer also to citation(s) 44474, 44634

45 EXPLOSIONS AND EXPLOSIVES

4501 Chemical

Refer also to citation(s) 45162, 45500, 46652

46027 (LA-UR–88-3161) **NTO development at Los Alamos.** Chapman, L. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890926–1: 9. international symposium on detonation, Sep 1989). Order Number DE89000356/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

NTO is an explosive with calculated performance near that of RDX but with sensitivity approaching that of TATB. Possible uses for NTO would be as an alternative to RDX in formulations where a lower sensitivity is desired or as an alternative to TATB where more performance is required without a large increase in sensitivity. Efforts have been concentrated on producing NTO and in testing the performance and sensitivity of NTO and NTO formulations. One-hundred pounds of NTO have been produced and some performance and sensitivity data have been obtained. Work is being

done to determine the diameter effect for large-crystal-size NTO. Additional work is being done to improve the small-charge diameter performance of NTO by adding small amounts of RDX or by changing the crystal size and/or crystal habit of the NTO. 1 fig., 3 tabs.

46028 (LA-UR–89-376) **Free-expansion experiments and modeling in detonation: Chemistry and hydrodynamics on a laboratory scale.** Greiner, N.R.; Blais, N. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–19: 9. international symposium on detonation, 28 Aug - 1 sep 1989). Order Number DE89007748/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Laboratory-scale (25-50 mg) detonations of PETN, RDX, HNS, and TNT have been carried out in a high-vacuum chamber, and collisionless molecular beams of the freely expanding detonation products have been analyzed as a function of time with a mass spectrometer. Concurrently, time-sequenced schlieren and shadowgraph images of the initial expansion of the product plume are recorded using a pulsed laser for illumination. These data tie the chemistry and hydrodynamics of the detonation event together. The results, interpreted with the aid of a computer model, suggest that this experiment freezes the chemical reactions of detonation by rapid adiabatic cooling and provides a continuum of samples in the molecular beam, representing the sequence of reactions in the detonating charge. With a suitable model of the expansion hydrodynamics, the hydrodynamic histories of a sequence of volume elements can be associated with their frozen chemistries. We expect experiments like this to provide a test for molecular models of detonation. 10 refs., 5 figs.

46029 (LA-UR–89-407) **Effects of binder concentration on the properties of plastic-bonded explosives.** Steele, R.D.; Stretz, L.A.; Taylor, G.W.; Rivera, T. Los Alamos National Lab., NM (USA). [1989]. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–18: 9. international symposium on detonation, 28 Aug - 1 sep 1989). Order Number DE89007744/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A series of plastic-bonded explosives (PBX) has been formulated with more binder than is normally contained in high-energy formulations. Adding a relatively small amount of binder to a material such as PBX 9501 [95/2.5/1.25/1.25 wt % HMX/Estane/BDNPA/BDNPF (the BDNPA and BDNPF form a eutectic that is frequently called simply the eutectic)] was found to decrease the shock sensitivity while not decreasing the energy of the explosive. The best compromise for a PBX 9501-type material contains about 92 wt % HMX. Adding additional binder does not continue to decrease the gap sensitivity of the formulation; however, the energy of the PBX decreases as expected. The higher-binder formulations are of potential use because of the possibility of formulating a PBX with energy similar to TATB formulations, such as PBX 9502 (95/5 wt % TATB/Kel-F 800), and with a higher strain to failure. 2 refs., 4 figs., 1 tab.

46030 (LA-UR–89-602) **In-situ study of the chemically driven flow fields in initiating homogeneous and heterogeneous nitromethane explosives.** Sheffield, S.A.; Engelke, R.; Alcon, R.R. Los Alamos National Lab., NM (USA). 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890811–8: 9. international symposium on detonation, 28 Aug - 1 sep 1989). Order Number DE89008415/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Electromagnetic gauging has been used to make in-situ measurements of particle velocity and impulse at five Lagrangian positions in nitromethane (NM) during gas-gun-driven, shock-to-detonation experiments. Homogeneous initiation experiments were conducted using NM that was chemically sensitized (using an organic base) and heterogeneous initiation experiments were done with physically sensitized NM (using silica particles). In the homogeneous initiation experiments, some of the features we observed are consistent with the classical homogeneous initiation model, however, our measurements show that the superdetonation does not form immediately after an induction time. Considerably behind the initial shock, reaction causes a wave to build up over a discernible length and this wave evolves into a superdetonation which catches the initial shock. In the heterogeneous initiation experiments, the waveforms indicated that wave growth occurs primarily in the shock front, similar to earlier observations in other heterogeneous explosives. 21 refs., 8 figs., 3 tabs.

46031 (LA-UR–89-2716) **Crystal orientation effects in PETN explosive with 4 GPa shocks.** Dick, J.J.; Pettit, D.R.; Spencer, W.J. Los Alamos National Lab., NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–32: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016996/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Shock initiation of detonation has been observed in PETN crystals of ⟨110⟩ orientation at the low shock strength of 4.25 GPa. This result explains some observations by other workers at Los Alamos National Laboratory that were considered anomalous. Chemiluminescent emission from the shock-induced decomposition reactions has been observed using OMA spectrographs, photodiodes, and image intensifier cameras. The emission is not seen in the insensitive orientations, ⟨100⟩ and ⟨101⟩; these orientations can deform using the primary slip plane, ⟨110⟩. 4 refs.

46032 (LA-UR–89-2723) **Laser-driven miniature flyer plates for shock initiation of secondary explosives.** Paisley, D.L. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–21: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016587/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Miniature flyer plates (<1-mm diameter X <5-micron thick) of aluminum and other materials are accelerated by a 10-ns pulsed Nd:YAG laser to velocities >5 km/s. Velocity profiles are recorded by velocity interferometry (VISAR) techniques and impact planarity by electronic streak photography. Techniques for improving energy coupling from laser to flyer plate will be discussed. Flyer plate performance parameters will be compared with material properties. The $P^n t$ criteria for shock initiation of explosives will be compared for various flyer materials, pressure, and pulse duration. Performance of secondary explosives (PETN, HNS, HMX, various PBX, others) will be reported. These data will detail the experimental effect of t (in $P^n t$) approaching values of a few nanoseconds. 9 refs., 5 figs.

46033 (LA-UR–89-2734) **Preliminary report confined tension testing of 900-24.** Harlow, R.A.; Browning, R.V. Los Alamos National Lab., NM (USA). 10 Sep 1988. 24p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8908128–1: Western Regional Strain Gage Committee meeting, 22 Aug 1989). Order Number DE89016595/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A specially designed confining pressure vessel is described that allows tensile samples to be tested under a superimposed confining hydrostatic pressure. Tests on samples of well characterized materials such as aluminum were used to verify the operation of the system, calibration of the internal load cell, and data reduction methods. The results of a series of exploratory tests done on the inert material 900-24 are described. 4 refs., 17 figs., 2 tabs.

46034 (LA-UR–89-2791) **Sharp shock model for propagating detonation waves.** Bukiet, B.; Menikoff, R. Los Alamos National Lab., NM (USA). 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–38: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016772/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Recent analyses of the reactive Euler equations have led to an understanding of the effect of curvature on an underdriven detonation wave. This advance can be incorporated into an improved sharp shock model for propagating detonation waves in hydrodynamic calculations. We illustrate the model with two simple examples: time dependent propagation of a diverging detonation wave in 1-D, and the steady 2-D propagation of a detonation wave in a rate stick. Incorporating this model into a 2-D front tracking code is discussed. 20 refs., 3 figs.

46035 (SAND–88-2385C) **A shock initiation model for fine-grained hexanitrostilbene.** Kipp, M.E.; Setchell, R.E. Sandia National Labs., Albuquerque, NM (USA). 1989. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–5: 9. international symposium on detonation, 28 Aug - 1 sep 1989). Order Number DE89007641/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An established body of data indicates that very fine-grained hexanitrostilbene (HNS), when pressed to 92% of crystal density, exhibits shock initiation characteristics unlike those typical of porous, granular explosives. That is, a progressive buildup towards detonation from an initial shock by hot spot formation and growth processes is not observed. Instead, this particular HNS exhibits shock initiation characteristics normally associated with homogeneous explosives (e.g., the formation of a superdetonation wave after an initial shock has been introduced). In the present work, a comprehensive effort has been made to develop a predictive model for shock initiation in this material. This model is based on a theory of homogeneous reactive mixtures, and includes a refined equation of state for porous HNS reactant and a JWL equation of state for gaseous reaction products. The model has been incorporated into wave propagation codes, and comparisons with available initiation data are made. 22 refs., 8 figs.

46036 (SAND–88-2465C) **Laser initiation of secondary explosives: Renlund paper No. 115.** Renlund, A.M.; Stanton, P.L.; Trott, W.M. Sandia National Labs., Albuquerque, NM (USA). [1989]. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890926–2: 9. international symposium on detonation, Sep 1989). Order Number DE89010229/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

Several experiments were performed to investigate the effects of explosive material parameters on energy thresholds for direct laser initiation of secondary explosives. Laser energy requirements for initiation of pentaerythritol tetranitrate (PETN) were decreased for small particle size powder and low density pressings. Promptness of detonation, however, was aided by higher densities. Initiation of PETN was achieved at energies at or below 10 mJ (power densities ~0.2 GW cm^{-2}) at laser wavelengths of 1.06 μm, 532 nm and 355 nm and strong confinement of the explosive sample assisted build-up to detonation. At 355 and 308 nm PETN could be initiated by irradiation on the bare explosive surface. Hexahydro-1,3,5-trinitro-s-triazine (RDX) was initiated at 308 nm but not at 1.06 μm. Hexanitrostibene (HNS) by direct irradiation at any of these wavelengths was successful. The results suggest that if sufficient energy is deposited, a fast deflagration or convective burn is achieved and that this grows to detonation via a conventional deflagration-to-detonation transition (DDT). 14 refs., 6 figs., 2 tabs.

46037 (SAND–88-2618C) **Time-resolved mass spectrometry technique for studying fast transient CHNO explosive decomposition kinetics.** Skocypec, R.D.; Erickson, K.L. Sandia National Labs., Albuquerque, NM (USA). 1989. 21p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–27: 9. international symposium on detonation, 28 Aug - 1 sep 1989). Order Number DE89016540/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An experimental system is being developed to study the fast transient kinetics governing solid-phase decomposition and subsequent interaction with decomposition products. The first phase of this work addresses the decomposition step. The experiment integrates a thin-film sample configuration with two chemical diagnostic techniques, time-of-flight mass spectrometry and time-resolved infrared spectral photography, and a pulsed-laser heat source. The experiment has microsecond temporal resolution to examine both condensed-phase mechanisms and concurrent gas-phase species evolution from samples at temperatures up to 1000°C. Experiments are underway to demonstrate and assess the use of thin-film samples with the experimental system. Results of these experiments, the diagnostic capabilities of the experimental system, and the advantages, preparation and characterization of thin-film samples are presented. 16 refs., 10 figs.

46038 (SAND–88-2766C) **Shock behavior of explosives about the c-j [Chapman-Juget] point.** Cooper, P.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890811–6: 9. international symposium on detonation, 28 Aug - 1 sep 1989). Order Number DE89007642/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Experimental data for pressure and particle velocity along the Hugoniot of detonation reaction products for a number of explosives are correlated in a reduced parameter form P/P_{cj} versus u/u_{cj}. Two correlations are found: $P/P_{cj} = a + b(u/u_{cj}) + c(u/u_{cj})^2$ when $P/P_{cj} > 0.08$, and $P/P_{cj} = m(u/u_{cj})^n$ when $P/P_{cj} < 0.08$. The correlations yield results that agree reasonably with code calculations. 13 refs., 3 figs., 1 tab.

46039 (SAND–89-0320C) **Estimation of the C-J pressure of explosives.** Cooper, P.W. Sandia National Labs., Albuquerque, NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909113–2: 14. international pyrotechnics seminar, 18-22 Sep 1989). Order Number DE89013811/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The correlation of a broad experimental data base yields a power function relationship between ρ_{cj} and ρ_0. Combining this function with the Rankine-Hugoniot equations for mass and momentum, an equation can be derived to estimate simply and accurately (within an average error of 5.7%) the value of P_{cj}, when ρ_0 and D are given. This estimating equation is $P_{cj} = \rho_0 D^2(1 - 0.713\ \rho_0^{0.03})$. 39 refs., 1 fig. 2 tabs.

46040 (SAND–89-1043C) **Response of standardized PVDF piezoelectric polymer gauges to direct shock pressures between 8 and 32 GPa.** Moore, L.M.; Graham, R.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-890812–37: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016811/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Previous fundamental studies of the response of standardized piezoelectric polymer stress gauges have been largely based on impact experiments in which peak pressures as high as 46 GPa are achieved by "ringing up" to peak pressure in times of about 60 nsec. The shock-induced increase in temperature is minimized in this case. In order to study thermal effects and other possible influences in PVDF piezoelectric response, direct shock loading to high pressures have been carried out in high explosive plane-wave loading experiments. Measured piezoelectric charges to pressures up to 10 GPa are found to the the same in both ring-up and direct shock loading. At peak pressures of 32 GPa, the observed charge is reduced by about 20% in the direct shock experiments. 2 refs., 5 figs., 1 tab.

46041 (UCRL-Trans–12241) **Decomposition kinetics and mechanism of explosive chemicals.** (Zha yao ke fen jie de dong li xue he ji li). Lin Ziru; Zi Deying; Wu Chengun; Zhang Mingnan. 17p. Translated from Binggong Xuebao, No. 2, May 1986, pp. 20–29. *Binggong Xuebao (China)*, (2): 20-29 (May 1986). Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48.

Thermal decompositions of linear nitroamines, $R[N(NO_2)CH_2]_mN(NO_2)R$ (R = H, CH_2Cl, and CH_2N_3; m = 1, 2, and 3), were studied by the DTA-IR combination analysis technique and a technique for monitoring the thermal decomposition process with a thermolysis-IR analysis system. The activation energies of the major decomposition reactions were determined and the possible decomposition mechanisms were proposed. A nitroamine polymer, $R[N(NO_2)CH_2]_nN(NO_2)R$ (n > 7), was formed during the decomposition process of some nitroamines. The conditions for the formation of this polymer have been also discussed. 8 refs.

4502 Nuclear

Refer also to citation(s) 45501, 46783

46042 (AD-A–207880/6/XAB) **Slab-model analysis of magnetic and collisional-viscosity effects on the first generation of**

nuclear structure. Interim report. Zalesak, S.T.; Huba, J.D.; Satyanarayana, P. Naval Research Lab., Washington, DC (USA). 27 Apr 1989. 30p. (NRL-MR–6431). Available from NTIS, PC A03/MF A01.

A simple model is postulated for the freezing scale in nuclear plumes, whose success depends strongly on the high M ratios of nuclear plumes, and on the existence of some mechanism which causes the slab growth rate gamma(k) to be sharply peaked when regarded as a function wavenumber k. Although the model derivation is quite different from another mode, the only significant difference in implementation is the use of growth rates valid for all gradient scale lengths, rather than for just the asymptotic long-wavelength limit. This model is only two-dimensional, and hence does not address three dimensional effects, which may be important.

46043 (AD-A–208073/7/XAB) **How nuclear war might start: Scenarios from the early 21st century. Interim report.** Digby, J.; Millot, M.D.; Schwabe, W.L. RAND Corp., Santa Monica, CA (USA). Oct 1988. 139p. (RAND/N–2614-NA). Available from NTIS, PC A07/MF A01.

Scenarios are a useful way to make responsible officials think hard about the future. For officials in the Department of Defense, some of these scenarios must consider the actual use of nuclear weapons, so that they will be better prepared to avoid such situations. To encourage breadth in the formulation of games for official purposes, RAND responded to a request from the Director of Net Assessment to create a number of scenarios for the early 21st century in which conflict would occur or be likely and in which due attention would be given to the political and technological conditions that might then be operational. This Note presents a wide range of such scenarios in sketch form. Several of the scenarios assume varying degrees of success for elements of the current Strategic Defense Initiative program, for new applications of stealth technology, for the National Aerospace Plane, for nonnuclear strategic weapons, and for new surveillance techniques. Applications range from battlefield uses to strategic options.

46044 (DOE/DP–0068) **Defense Programs.** USDOE Assistant Secretary for Defense Programs, Washington, DC (USA). May 1989. 13p. Sponsored by U.S. DOE Defense Programs. Order Number DE89016065/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The following will help you to understand how the US Department of Energy's (DOE) Defense Programs (DP) carries out its national security responsibilities, and includes information about the kinds of programs we manage and where facilities are located. Our more than 60,000 employees and contractor personnel work at two headquarters locations in the Washington Metropolitan area and at various research, production, and test sites throughout the country. While each field facility has its own unique functions, most DP activities involve collaboration between two or more locations. DP's partners in progress encompass thousands of "outsiders" as well, including members of the academic community, industrial leaders, a number of other US Government agencies, and foreign countries. The major program area in DP are: Weapons Activities, Nuclear Materials Production, Defense Waste and Transportation Management, Verification and Control Technology, Nuclear Safeguards and Security, Classification and Technology Policy, and Intelligence. Defense Programs activities include the research, development, testing, manufacture, and retirement of all US nuclear weapons; the production of all nuclear materials needed for the weapons program; and the management of defense-related nuclear wastes. Other responsibilities include developing inertial confinement fusion to support defense needs; strategic defense research; protecting and safeguarding the DOE nuclear materials and facilities; verifying international arms control agreements and controlling sensitive technology transfers; classifying and disseminating information; and administering activities involving nuclear weapons under international agreements for cooperation.

46045 (PB–89-200208/XAB) **Assessment of need for and design requirements of a wind-tunnel facility to study fire effects of interest to DNA.** Pitts, W.M. National Inst. of Standards and Technology (NEL), Gaithersburg, MD (USA). Center for Fire Research. May 1989. 209p. (NISTIR–89/4049). Available from NTIS, PC A10/MF A01.

The objective of this study is to recommend whether or not a new wind tunnel facility should be designed and constructed for the investigation of wind-aided fire spread. The focus is on the types of mass fire that can be expected following a nuclear detonation above an urban environment. The final conclusions of the report are (1) the need for an improved understanding of urban fire spread as it relates to nuclear weapon effects is overwhelming, (2) the authors currently have essentially zero predictive capability for fire damage in an urban environment following a nuclear attack, (3) wind tunnel experiments will not provide all of the required information, but offer the opportunity to substantially improve the understanding of the problem, (4) most existing wind tunnels were designed decades ago and are not well-suited for the required experimentation, and (5) some progress can be and is being made in existing facilities, but substantial improvements in understanding require a new facility and a sustained commitment for support.

46046 (SAND–89-1243) **DOE [Department of Energy] nuclear weapon R and T [research, development, and testing]: Objectives, roles, and responsibilities.** Otey, G.R. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 33p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89014019/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An overview of the DOE nuclear weapons research, development, and testing program is given along with a description of the program objectives and the roles and responsibilities of the various involved organizations. The relationship between the DoD and DOE is described and the division of responsibilities for weapon development as well as the coordinated planning and acquisition activities are reviewed. Execution of the RD&T program at the nuclear weapons laboratories is outlined. 24 refs., 3 figs.

46047 Cold thoughts on nuclear winter. Katz, J.I. *Transactions of the American Nuclear Society (USA),* 55: 26 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

The nuclear winter controversy is a notorious example of the politicization of science. Large firestorms are followed by soot-laden black rain. It is not known what fraction of the soot produced by fires is removed from the atmosphere in this manner. A simple argument suggests that the fraction may be large. It is even possible to argue that a severe nuclear winter is not self-consistent. It is often assumed that carbonaceous soot is chemically inert in the atmosphere, despite the presence of trace amounts of chemically active species. Even if the magnitude of the nuclear winter effect were known, its implications would remain controversial. Nuclear winter chillings are usually measured as drops in mean temperature. However, reduction in solar heating reduces the diurnal variation as well.

46048 Cleansing of the atmosphere: smoke removal under natural and perturbed conditions. Hallett, J. *Transactions of the American Nuclear Society (USA),* 55: 26-27 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

The overall cleansing of the atmosphere can be related to the efficiency of the precipitation system, which is small for individual cumulus clouds (O), intermediate for air mass thunderstorms (20%), and larger for a steady-state system such as a supercell or a depression (70%). Air processed by the storm is cleaned of its aerosol loading, depending on the detail of the microphysical process. It follows that in any disaster scenario whereby large amounts of smoke are emitted into the troposphere - volcanic eruption, comet impact, nuclear exchange fires - the immediate cloud forming and precipitation processes are of major importance in determining the scavenging rate and overall scavenging efficiency. Even in the unpolluted atmosphere, removal by any precipitation process depends critically on the likelihood of the aerosol containing air passing into a suitable precipitation system. In the case of Chernobyl, with iodine-activated soot, its removals is more likely as it passes into an ice-forming precipitation system, to be removed directly by ice nucleation. In the present atmosphere, statistics of parcel trajectory can give a mean removal rate; in the case of the perturbed atmosphere, major uncertainties remain on the nature and scale of the initial circulations.

46049 Generation of graphitic soot by an urban fire storm. Fields, D.E. (Oak Ridge National Lab., TN (USA)); Cole, L.L. *Transactions of the American Nuclear Society (USA),* 55: 27-28 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

The authors have obtained samples of aerosols deposited during the Hiroshima fire storm that was initiated by the atomic bomb detonated on August 6, 1945. These particles, which we extracted from streaks of black rain found on a plaster wall, are being studied. Initial studies show that the artifact appears to contain aerosol particles that may be representative of the aerosols that may lead to a nuclear winter. Aerosol generation in urban fire storms have been considered by studying these particles. The presence of graphite as a component of these particles is suggested by electron photomicrographs and has been confirmed using Raman spectroscopy, surface ionization mass spectroscopy, and electron scattering for chemical analysis. Several hypotheses are being considered to explain the presence of this form of carbon. Among these are generation in sooty clouds, in raindrops, in the interior of the first storm, and on the wall surface itself. The distribution of particle sizes suggests that the residence time of particles in the atmosphere would be long if they were not removed by rainout. An experimental and theoretical examination of the conditions necessary to produce graphitic soot is in progress.

46050 Defense nuclear agency - global effects program. Auton, D. (Defense Nuclear Agency, Washington, DC (USA)). *Transactions of the American Nuclear Society (USA),* 55: 28-29 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

Considerable progress has been made in the determination and analysis of fuel inventories and their distribution. Nonurban inventories are reasonably well documented and probably sufficient for most global effects analyses. Urban inventories are now in good shape for the United States. Work remains to be completed for European and Soviet urban areas. The largest single uncertainty and driving force for all subsequent analyses is the scenario. Knowing the fuel inventories and their distribution is critical and allows scenario assumptions to be played against the fuel bed data. The second largest uncertainty areas is the amount of smoke that would be produced for any given scenario. Much research is under way that contributes to resolving this issue, but there remain the following nagging problems: (1) dynamics of fire spreading and fire zone behavior; (2) scaling from laboratory and small-field measurements; and (3) relatability of materials burned in item 2 to the real case of interest.

46051 Nuclear late fall. Harris, T.R. *Transactions of the American Nuclear Society (USA),* 55: 29-30 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

This paper examines the policy implications of nuclear winter. The work begins by looking at policy responses to early research, such as the TTAPS study and its precursors, and traces the evolution of responses as the research progressed through the ENUWAR study. Finally, the range of possible current policy responses to the more modest predictions is examined. Additionally, ancillary impact assessment work is also considered.

46052 Extinction cascade: biological consequence of nuclear war/winter. Vaughan, G.L. (Univ. of Tennessee, Knoxville (USA)); Pimm, S.; Fields, D.E. *Transactions of the American Nuclear Society (USA),* 55: 30-31 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

Current estimates suggest that direct human casualties in a full-scale nuclear war will exceed one billion people, largely centered around urban and military/industrial centers of the northern hemisphere. The sheer magnitude of potential for immediate human death and suffering in nuclear attack and retaliatory response has served as an effective deterrent for >40 yr. It has become apparent, however, that short-term human mortality and mobidity may not be the factors of greatest concern. It is probable that a larger impact may be attributable to long-term environmental degradation. The general consensus is that a large nuclear war would produce enough smoke to alter and darken the atmosphere so that most of the northern hemisphere would experience reduced temperature, low light levels, altered rainfall patterns, and toxic smog/rain as well as significant exposure to radioactive fallout. Analysis of the environmental changes associated with early nuclear winter scenarios showed a potential for the extinction of a large portion of the earth's plants and animals. Estimates of nuclear winter consequences contain considerable uncertainty. The considerable uncertainties contained in nuclear winter predictions are mentioned. Considering these uncertainties, it is difficult to make definitive statements about the survival of any individual species. It is not, however, difficult to predict that, even with the mitigated nuclear autumn scenario, a mass extinction of biological species, floral and faunal, will result from large-scale nuclear war.

46053 Nuclear winter: the implications for civil defense. Chester, C.V. (Oak Ridge National Lab., TN (USA)); Perry, A.M.; Hobbs, B.F. *Transactions of the American Nuclear Society (USA),* 55: 31-32 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

It is generally believed possible for some range of heavy nuclear attacks directed against cities that significant but not lethal climate alteration will ensue for at least a few weeks. Three-dimensional global circulation models being developed and used at Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and the National Center for Atmospheric Research for a reasonable attack size seem to be converging on a temperature depression of the order of 10 to 15°C, averaged over all land areas of the temperate region of the northern hemisphere. Temperature depressions as large as 25°C are predicted in the interiors of continents for attacks in the summertime. Winter wars produce temperature depressions of only a few degrees. The authors have drawn the following implications for civil defense of the possibility of nuclear winter: (1) Neither cold nor drought is likely to be a direct threat to human survival. (2) The principal threat of nuclear winter is to agriculture. (3) Nuclear winter does not present an entirely new threat from nuclear war to the United States or the Soviet Union. (4) The consequences of nuclear winter would fall more heavily on the Soviet Union.

46054 Consequences of nuclear winter. Teller, E. (Lawrence Livermore National Lab., CA (USA)). *Transactions of the American Nuclear Society (USA),* 55: 32 (1987). (CONF-871101–: Joint meeting of the American Nuclear Society and the Atomic Industrial Forum, 15-19 Nov 1987).

It is to be expected that the predictable consequences of a nuclear war are more terrible than any of the indirect effects that have been discussed. Detailed calculations on the consequences of massive release of smoke seem to bear out this general expectation. This contrast may become ever more obvious if one takes into account the consequences of defense against a nuclear attack. One cannot expect that such defense will be 100% effective. A reduction of the direct casualties by a factor of 2 will almost certainly result in a substantial reduction in the amount of smoke emitted. In case of no defense, the direct effects of nuclear winter are hard to predict. In the case of defense, the climate changes may well be minor. If one assumes that there will be residual effects on the weather, this is apt to be more important in influencing precipitation rather than the surface temperature. Indeed, the main effect of smoke is to produce a temperature inversion and thereby suppress the convective rainfall. This is particularly true in many regions that produce crops in the norther hemisphere. It seems now well established that the most dangerous potential consequence of any smoke-induced climatic change will be reduction of crops. Fortunately, this danger can be greatly reduced by food storage. Such food storage could greatly reduce domestic shortages in the United States and could also be important in alleviating suffering abroad. The efforts spent on considering the consequence of nuclear winter are not wasted.

4503 Explosion Detection

46055 (SAND–89-0832) **Methods for detecting seismic events at known locations using NORESS [Norwegian Experimental Seismic System] data.** Lee, D.O.; Stearns, S.D.; Wayland, J.R. Jr. Sandia National Labs., Albuquerque, NM (USA). Mar 1989. 44p. Sponsored by U.S. DOE Defense Programs. DOE Contract

AC04-76DP00789. Order Number DE89016921/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The difficulty of detecting, locating and identifying low-magnitude seismic events has been an ongoing problem. In this note, we describe processing methods that help us to find low-magnitude seismic events. A series of algorithms with beamforming has been developed and has proven effective in helping to discover very low yield events. The beamforming technique consists of determining the array element time delays for the specific source region using previously established events. This allows us to concentrate the array to look at the specified source location. Examples of this type of analysis are provided. In the analysis of seismic data one may be in possession of other information, e.g., newspaper reports of an earthquake. Using this information to concentrate the search for an event will often identify an otherwise overlooked signal. The algorithms for this type of search are incorporated into computer software that includes capabilities for plotting, spectral and signal-to-noise estimation, direction finding, and other functions. 2 refs., 25 figs.

50 ENVIRONMENTAL SCIENCES, ATMOSPHERIC

Refer also to citation(s) 46198

46056 (IC–89/34) **Model for the simulation of the ozone budget in the atmosphere under anthropogenic perturbation.** Bestman, A.R. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 10p. Order Number DE89636294/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A simple model is proposed for the laboratory simulation of the anthropogenic perturbation of the ozone (O_3) in the middle atmosphere. It consists of two vertical plates maintained at very high but nearly equal temperatures, in between which is a binary mixture of a chemically reacting fluid. The plates are rotated about a horizontal axis. Adopting the optically thin non-grey gas approximation for radiative heat transfer, the differential equations governing the velocity components, temperature and mass concentration are integrated in a close form. The solutions show good agreement with the exact integral formalism for the radiative flux under the same assumption of nearly equal wall temperatures. (author). 7 refs, 1 fig.

5001 Basic Studies

Refer also to citation(s) 46045

46057 (AD-A–207667/7/XAB) **Strategic high-altitude atmospheric radiation code (SHARC) user instructions. Technical report, September 1987-January 1989.** Sundberg, R.L.; Duff, J.W.; Bernstein, L.S.; Acharya, P.K.; Gruninger, J.H. Spectral Sciences, Inc., Burlington, MA (USA). 3 Feb 1989. 175p. (SSI-TR–152). Available from NTIS, PC A08/MF A01.

This report describes how to implement and use the Strategic High-Altitude Radiance Code (SHARC). SHARC calculates atmospheric radiation for paths from 60 to 300 km altitude in the 2-40 micrometer spectral region. It models radiation due to NLTE (Non-Local Thermodynamic Equilibrium) molecular emissions which are the dominant sources at these altitudes. This initial version of SHARC includes the five strongest IR radiators, CO_2, NO, O_3, H_2O, and CO. The code is available on magnetic tape and can be obtained by written request to AFGL/OPB.

46058 (CEA-CONF–9764) **High-frequency paleoclimatic variability: a spectral analysis of the Vostok ice-core isotopic record.** Yiou, P.; Genthon, C.; Jouzel, J.; Le Treut, H.; Lorius, C.; Ghil, M.; Korotkevich, Y.S. CEA Centre d'Etudes Nucleaires de Saclay, 91 - Gif-sur-Yvette (France). Dept. de Physico-Chimie. 1988. 4p. (CONF-8806390–1: Scaling, fractals and non-linear variability in geophysic, 27 Jun - 1 jul 1988). Order Number DE89791934/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

This paper uses a recently analysed isotopic record from an ice core drilled at the Soviet Antartic Station VOSTOK, representing a total time span of about 160,000 years. Results obtained show the existence of a significative climatic variability at the time scale of 10,000 years and below. The many spectral peaks appear to be approximate linear combination of a little number among them, a clear indication of the non linear nature of climate fluctuations at these "short" time scales.

46059 (DOE/ER/60590–T2) **Meteorological support for space operations: Review and recommendations.** Hosler, C.L.; Forbes, G.S.; Klemp, J.B.; Krider, E.P.; McGinley, J.A.; Ray, P.S.; Snellman, L.W. National Research Council, Washington, DC (USA). Panel on Meteorological Support for Space Operations. [1989]. 86p. Sponsored by DOE/ER;NASA. DOE Contract AI01-87ER60590. Order Number DE89016113/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This report recommends mechanisms by which NASA can put into operation state-of-the-science meteorological technology and advanced weather forecasting techniques to enhance the efficiency, reliability, and safety of space operations. The spirit motivating these recommendations is the panel's belief that NASA should strive to exploit the benefits of the cutting edge of new meteorological technology, just as it exploits the potential of the numerous other technologies that support space flight. In striving to reach this goal, NASA can pave the way for many other applications of these advanced meteorological capabilities.

46060 (EPRI-EL–6413) **Lightning flash characteristics, 1987.** Orville, R.E.; Henderson, R.W.; Pyle, R.B. Electric Power Research Inst., Palo Alto, CA (USA); State Univ. of New York, Albany, NY (USA). Dept. of Atmospheric Science. c Aug 1989. 49p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

A magnetic direction finding system for the detection of lightning flashes to ground has operated in the eastern part of the United States since 1982 and has now expanded to cover over 80 percent of the contiguous United States. Complete coverage is planned for the end of 1988. Time, location, flash polarity, multiplicity (the number of strokes per flash) and the initial peak magnetic radiation field amplitude are recorded in real time. Flash locations, time, polarity, peak current, and multiplicity are displayed routinely for research and operational uses. New results for 1987 include the flash density for strikes to ground in the peak current ranges 0–35 kA, 35–65 kA, 65–100 kA and greater than 100 kA. The lightning information is available to utilities through a satellite communication link for real time access or by phone lines for access to historical data, where the last five million flashes are available. The flash information is being compiled into a data base to provide statistical information necessary for the prediction of the surge performance of electric power lines and the improvement of surge protection practices. Results for the year 1987 are presented in this report. 13 refs., 25 figs.

46061 (LA-SUB–89-1) **DEWFALL X.0 (unverified prototype): Engineering software for non-steady radial energy transfer with vaporization/condensation: Draft user manual.** Walsh, B.; Ruiz, N.; Mattingly, P. Los Alamos National Lab., NM (USA); Science and Engineering Associates, Inc., Santa Fe, NM (USA). 1 Jun 1989. 250p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (SEASF-TR–89-001). Order Number DE89016311/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

This manual documents the input requirements, execution procedures and output for the unverified prototype of DEWFALL and its postprocessor, DEWPOST. It also describes the purpose and limitations of the software, the physical model that underlies it, and the rationale for the physical model. Instructions for installing and maintaining the software are also included in this manual. It is addressed to users at the developing organization, Science and Engineering Associates, Inc., (SEA), and at the sponsoring organization, Los Alamos National Laboratories (LANL).

46062 (LBL–27436) **Integrated data bases in environmental health applications.** Merrill, D.W. Lawrence Berkeley Lab., CA (USA). Jun 1989. 6p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8906198–1: Environmental databases workshop, 19 Jun 1989). Order Number DE89016339/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Increasingly, public attention is focusing on the health effects of environmental hazards including air pollution, radioactive and toxic wastes, and indoor radon. Typical exposures are at low levels, and have a geographic distribution that can be estimated a priori. In such cases, analysis of routinely collected health surveillance data can be faster, cheaper and more sensitive than specially designed case-control or cohort studies. The health data are linked by geographic location with independently collected census data and environmental exposure data. The units of analysis are geographic areas rather than individuals; such data are known as ecologic data. In analyzing such data, rates calculated for individual subareas are not a suitable measure of risk. If the subareas are too small, stable rates cannot be calculated; if too large, geographic detail is lost. In either case one cannot easily describe trends which vary smoothly across adjacent subareas. We describe a preferred alternative, the mathematical technique of density equalizing map projections. Because ecologic data often cover broad areas and long time periods, the same data find repeated use in different applications. Comprehensive data files are generally too large and complex for commercial data base systems. Conventional analytical techniques are not generally valid for ecologic data. Below the county level, geographic data integration is a difficult task requiring the use of geographic base map files. For all these reasons it is cost effective to permanently integrate major ecologic data files in a publicly shared computing environment.

46063 (PNL–6279-Vol.10) **Hanford Meteorological Station computer codes: Volume 10, The ARCHIVE computer code.** Andrews, G.L.; Burk, K.W. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 101p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE89016175/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The purpose of the ARCHIVE computer program is twofold: (1) convert selected hourly binary data into formatted ASCII data, and (2) organize the converted data into monthly files. Formatted ASCII files are easier to access on a routine basis. The program is executed once a day and is initiated from a command file that submits itself to the SYS$BATCH queue on a daily basis. The monthly files are stored on the HMS computer's fixed hard disk and are merged into yearly files (located on removable disk packs) at the end of each year. This report describes the data bases maintained at the HMS, gives an overview of the ARCHIVE program, describes input and output files accessed by the ARCHIVE program, provides a description of program initiation, and discusses the limitations of the ARCHIVE program. A section on trouble-shooting is included. In addition, the appendixes contain flow charts, detailed descriptions, and source code listings for the ARCHIVE program and related subroutines. A description of the ARCHIVE command file and the data input and output files completes the report. 3 refs., 1 fig.

46064 (SAND–88-3470C) **Varistor-particle lightning arrestor connector performance under simulated extreme lightning currents.** Fisher, R.J.; Kostas, J.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909124–2: International conference on lightning and static electricity, 26-28 Sep 1989). Order Number DE89012663/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Varistor-particle lightning arrestor connectors have been tested under simulated lightning currents of peak amplitude up to 185 kA. Each connector was attached to a circuit of representative interest, in which currents were measured at various points. These currents were reproduced in post-test circuit modeling, during which voltages were determined throughout the circuit and response sensitivity to statistical variations in post-breakdown contact-arc voltage was demonstrated. In all cases, resultant downstream circuit voltages were well below the 1500-V criterion. 6 refs., 10 figs., 3 tabs.

46065 (SAND–88-3471C) **Internal voltages and currents in well-shielded cylindrical objects due to stimulated direct-strike lightning.** Fisher, R.J.; Warne, L.K.; Kostas, J.G. Sandia National Labs., Albuquerque, NM (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909124–3: International conference on lightning and static electricity, 26-28 Sep 1989). Order Number DE89012664/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

A variety of cylindrical tests objects of generic interest were tested to simulated severe direct-strike lightning with the intent of bounding possible internal voltages due to joint leakage and currents through low-impedance loads due to diffusion. All the test objects would normally be considered to be high-quality Faraday shields. The highest voltage recorded was 21 V, which was developed across a flange-and-collar joint in a steel cylinder driven longitudinally by a test current of ~160 kA peak. A simple circuit model of the symmetric diffusion process, valid over the frequency range of lightning, is given. 4 refs., 14 figs., 2 tabs.

46066 (SAND–89-1161C) **Data processing in lightning warning systems.** Edrington, T.S. Sandia National Labs., Albuquerque, NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909124–1: International conference on lightning and static electricity, 26-28 Sep 1989). Order Number DE89012495/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Data from an array of sixteen electric-field sensors have been used to evaluate the potential benefits to lightning warning systems of processing "old" data as well as data from off-site sensors. These specific topics are approached from a broad decision-theoretic viewpoint. 4 refs., 10 figs.

46067 (SAND–89-7099) **System guide to SPEEDI: The Sandia Partitioned Engineering Environmental Database Implementation.** Kephart, E.M.; Haskell, K.H.; von Laven, G.M. Sandia National Labs., Albuquerque, NM (USA); RE/SPEC, Inc., Albuquerque, NM (USA). Jul 1989. 119p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (RSI–0329). Order Number DE89015166/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

The goal of this undertaking has been for RE/SPEC to furnish technical and administrative coordination and to execute a three-phased project. The project consists of evaluating, designing, and implementing the required database access system. This report documents the software which has been developed, named the Sandia Partitioned Engineering Environmental Database Implementation, or SPEEDI. It is intended for personnel who are responsible for installing, maintaining, and enhancing SPEEDI, as well as for any programmer who wants to access SPEEDI through other software.

46068 The source term in energy deposition calculations. Penetrante, B. M. (Lawrence Livermore National Laboratory, Livermore, California 94550(US)); Bardsley, J. N. *Journal of Applied Physics (USA)*, 66(4): 1871-1874 (15 Aug 1989). DOE Contract W-7405-ENG-48.

A discrete-loss energy deposition model is used to study the functional dependence of the *W* value (mean energy expended per electron-ion pair) on the beam energy and ionization fraction. Two types of secondary electron source terms are considered: one in which energetic electrons are completely stopped by the medium, the other in which a continuous beam passes through the plasma. We show that the *W* value, and hence the energy-loss modes, strongly depend on the type of source term used.

5002 Chemicals Monitoring and Transport

Refer also to citation(s) 44502, 44519, 44796, 45189, 45439, 45720, 45874, 46119, 46120, 46133, 46327, 46330, 46357

46069 (CMHC–870730) **Residential combustion venting failure. A systems approach. Summary report.** Canada Mortgage and Housing Corp., Ottawa, ON (Canada). 1987. 145p. (CE–02714). Available from Canada Mortgage and Housing Corporation, Annex Bldg., 628 Montreal Rd., Ottawa, ON, CAN K1A 0P7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The project reported on here was to expand on previous studies of the problem of incomplete venting of the products of combustion from heating appliances in the Canadian housing stock. The work was subdivided into seven parts: a country-wide survey of approximately 100 houses, the refinement and extension of FLUE

SIMULATOR, a computer model originally developed in 1984-1985, to make it easier to use and to allow to model a wider variety of furnace/flue/house systems, the refinement of existing field detection procedures, a study of the pollutants likely to be released in a house as a result of failed or incomplete venting of combustion products and a study of the health hazards these pollutants might present, a review of remedial measures for correcting or avoiding combustion venting problems and research and development of the more promising such measures, an on-site investigation of problem houses found in the country-wide survey, and the definition of a strategy for disseminating the results of the project. The results indicate that a significant portion of the housing stock has potential for combustion venting failure to occur regularly, but such failures are not necessarily health-threatening. The project has resulted in a marked improvement in our understanding of combustion venting and has identified a number of preventive and remedial measures. 15 refs 26 figs 7 tabs

46070 (CONF-8711322–1) **Methodology for assigning uncertainty values to emissions estimates.** Bassett, G.W. Jr.; Chun, K.C.; Hanson, D.A. Argonne National Lab., IL (USA). [1987]. 10p. Sponsored by U.S. DOE Fossil Energy. DOE Contract W-31109-ENG-38. From Environmetrics '87; 15-18 Nov 1987. Order Number DE89016894/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The National Acid Precipitation Assessment Program (NAPAP) has been developing estimates of the precursors of acid rain as well as uncertainty values for the estimates. In this paper we briefly review some of the proposed methods for assigning uncertainty values to the emissions estimates. We also briefly discuss some of the general issues which have arisen in the process of developing uncertainty values. 3 refs.

46071 (CONF-8908108–1) **Analysis of soil chemistry data for an EPA [Environmental Protection Agency] acid rain assessment.** Wolf, D.A.; Brandt, C.C.; Schmoyer, D.D.; Turner, R.S. Oak Ridge National Lab., TN (USA). 1989. 17p. Sponsored by DOE/ER;EPA. DOE Contract AC05-84OR21400. From American Statistical Association meeting; 9 Aug 1989. Order Number DE89015364/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Direct/Delayed Response Project (DDRP), implemented by the US Environmental Protection Agency (EPA), as part of the National Acid Precipitation Assessment Program (NAPAP), was designed to project the long-term response of selected eastern US watersheds and surface waters to acidic deposition. Specific DDRP tasks include (i) to characterize variability of soil and other watershed attributes, (ii) to determine which of the soil and watershed characteristics are most strongly related to surface water chemistry, (iii) to estimate the relative importance of key watershed processes in controlling surface water chemistry, and (iv) to classify a sample of watersheds with regard to their response time and extrapolate the classification to the population of lakes and streams in the region. An overview of the DDRP is presented relating it to other EPA studies and describing its implementation. The main problems addressed are collinearity and variable selection in multiple regression when the number of variables exceeds the number of observations.

46072 (DOE/ER/60292–5) **Operation and research at the Ithaca MAP3S regional precipitation chemistry site: Annual progress report for 1989.** Butler, T.J.; Likens, G.E. Institute of Ecosystem Studies, Millbrook, NY (USA). Jul 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER60292. Order Number DE89016309/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Ithaca MAP3S Regional Precipitation Chemistry Site, in continuous operation since September 1976 is now operating on a daily sampling rather than event sampling basis. Two other network stations (NDDN and EFPVMN) are co-located currently at the site. Research associated with MAP3S over the last year includes an analysis of the impact of changing emissions levels on precipitation chemistry in the eastern US. From 1977 to 1986 a 20% change in SO_2 emissions and a 10% change in NO_x emissions have occurred over the eastern and midwestern US. Six continental precipitation chemistry sites from the MAP3S network, plus the Hubbard Brook Experimental Forest, New Hampshire, show a direct relationship between emission levels and precipitation concentrations, except for Penn State, Pennsylvania. MAP3S sites at Illinois and Ohio, located closest to the major SO_2 source regions, demonstrate statistically significant ($P < 0.05$) linear regressions of SO_4 concentrations on SO_2 emissions. Hubbard Brook shows the strongest relationship ($P < 0.01$) between SO_2 emissions and SO_4 concentration in precipitation. Only Whiteface Mountain, New York, shows a significant relationships ($P < 0.10$) for NO_x emissions and NO_3^- concentrations. However, Illinois, Ohio, Ithaca, and Hubbard Brook show significant linear regressions of H^+ concentrations on emissions of $SO_2 + NO_x$ ($P < 0.10$, 0.05, 0.05, and 0.01, respectively). Overall, for the entire region examined, decreasing SO_2 emission levels appear to have decreased SO_4 concentrations with an efficiency of 66% + 17% (s.e.).

46073 (DOE/ER/69014–T1) **Assessment of crop response to increases in atmospheric carbon dioxide concentrations: Summary of research progress report, July 1, 1988–June 30, 1989.** Agricultural Research Service, Beltsville, MD (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AI05-88ER69014. Order Number DE89016251/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

At Beltsville, the 2-dimensional soil model SOILSIM was purchased from a commercial company along with the rights to distribute our own modified version. The model as purchased dealt with the movement of water and solutes in both the unsaturated (rooted) and and saturated portions of the soil. It had simple empirical equations to simulate boundary conditions, no dictionary and very little comment in the code. However, it did have algorithms to predict correctly the movement of materials through a heterogeneous medium. In this respect it was much superior to the soil model RHIZOS incorporated in GLYCIM. Earlier use of the uncertainty analysis program PRISM had revealed how insensitive RHIZOS is to soil input variables and parameters. SOILSIM, has been adapted for use in crop models by inserting comments in the code, preparing a dictionary of variable and parameter names and units, stripping our code dealing with the deeper layers of the soil, and replacing the empirical boundary-condition equations with equations that link to the crop model. The modules dealing with soil water movement and root growth have been incorporated into GLYCIM. 6 refs.

46074 (ECN–89-114) **The influence of manganese leached from plants on dew chemistry.** Arends, B.G.; Eenkhoorn, S. Netherlands Energy Research Foundation, Petten (Netherlands). Jul 1989. 8p. Available from Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands.

High concentrations of manganese were found in dew water on grass which are believed to be catalytically active for the oxidation of sulfite. In order to describe this oxidation the reaction was studied in a fog chamber. In the concentration and pH range, normally found in dew on grass, the formation of sulfate is linearly dependent on the concentration of manganese and on the square root of the concentration of sulfite. The results indicate that the manganese catalyzed sulfite oxidation is an important reaction in dew on grass. 6 figs., 17 refs., 1 tab.

46075 (EPRI-EN–6492) **Acid precipitation and human health: Final report.** Hoffman, S. Electric Power Research Inst., Palo Alto, CA (USA); Hoffman (S.), Mountain View, CA (USA). c Aug 1989. 134p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

This report, written for environmental managers in electric utilities, reviews potential indirect human health effects of acid precipitation. Possible exposure routes and materials examined in this review include drinking water contamination (aluminum and mercury), corrosion of metals (lead, cadmium, arsenic, selenium, copper, and zinc) and asbestos from water piping, bioaccumulation of mercury and other metals in fish and game, and uptake of mobilized metals in crops. No direct effects (e.g., skin or eye irritation) of human exposure to acid precipitation have been identified, and air pollutant impacts on health are not included in this review, because these pollutants are acid precipitation precursors, not acid precipitation per se. The literature is summarized, presenting results from

researchers' studies to support their conclusions. The review discusses potential acid precipitation impacts on metal levels in drinking water and food, summarizes the health effects of ingestion of these materials, and identifies areas of needed research. Metal-metal interactions in humans that may be related to acid precipitation are identified. Current research programs and planned assessments of the indirect human health effects of acid precipitation are summarized. 136 refs., 38 figs., 17 tabs

46076 (ETDE-mf–9914837) **Emission of pollutants from small furnaces. Current status - measures for pollutant reduction - future points of main support.** Universitaet Stuttgart, Institut fuer Verfahrenstechnik und Dampfkesselwesen. Bericht. Struschka, M.; Straub, D.; Baumbach, G. Stuttgart Univ. (Germany, F.R.). Inst. fuer Verfahrenstechnik und Dampfkesselwesen; Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1988. 207p. (In German). Contract BMFT 01VQ3446. Order Number DE89914837/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

After looking at the 'state of the art' this study determines research and development projects that need to be undertaken on the area of cutting pollution by small furnaces. Based on energy consumption and heating structure the authors then describe the proportion of oil, gas coal and biogeneous fuels in the total consumption of the Federal Republic of Germany as a whole and of some districts. The basic facts about combustion and the resulting pollution are explained. Pollutant emission from small furnaces is described for each type of fuel. Parameters of combustion and emission of noxious substances are described in detail. Primary and secondary pollution abatement measures are listed and evaluated. Emission factors of various fuels and furnace types are compared. (HWJ).

46077 (GKSS–89/E/8) **Atmospheric input of trace substances into the North Sea and the Baltic Sea.** Grassl, H.; Eppel, D.; Petersen, G.; Schneider, B.; Weber, H.; Gandrass, J.; Reinhardt, K.H.; Wodarg, D.; Fliess, J. GKSS-Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.); Umweltbundesamt, Berlin (Germany, F.R.). Jan 1989. 165p. (In German). Contract UFOPLAN-Nr. 10402572. Order Number DE89914972/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

The concentrations and deposition of atmospheric trace substances were measured over the Kiel Bight and the Southern North Sea. A European longrange-transport model was used to calculate the atmospheric concentrations of trace metals and their deposition into the North Sea and the Baltic Sea. Natural and anthropogenic emitted element concentrations could be separated definitely by the measurements, and preferred transport directions of anthropogenic contributions could be found. Concentrations measured over the North Sea could be related to the surrounding emission areas by airmass trajectory analyses. The deposition measurements show that the main removal process is due to deposition by precipitation. Calculated and measured concentrations at several receptor points agreed well. The model results confirm the dominating role of wet deposition. It could be shown that extrapolations from measurements at coastal stations to the whole sea area tend to overestimate the total deposition into North Sea and Baltic Sea. (orig.) With 78 refs., 26 tabs., 85 figs.

46078 (IVL-B–922) **Influence of weather on pollution levels and deposition in Swedish background air.** Loevblad, G.; Omstedt, G.; Sjoeberg, K. Swedish Environmental Research Inst., Goeteborg (Sweden). Apr 1989. 65p. (In Swedish). Order Number DE89914804/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

Data from the EMEP network are evaluated to show the influence of weather conditions on air pollution concentrations and deposition in rural areas in Sweden. The highest concentrations of air pollutions are observed during movement of air masses from the south and east sectors, shortly after periods of high air pressure, cold weather and stable conditions in central Europe. The largest amount of wet deposition occur during periods of greatest precipitation, and the highest concentrations of pollutants in precipitation are observed during periods of low precipitation (<0.5 mm).

46079 (Juel-Spez–502) **CO_2-reduction potential through rational energy utilization and use of renewable energy sources in the Federal Republic of Germany.** Kolb, G.; Eickhoff, G.; Kleemann, M.; Krzikalla, N.; Pohlmann, M.; Wagner, H.J. Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Programmgruppe Systemforschung und Technologische Entwicklung. May 1989. 83p. Order Number DE89915136/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The paper analyses the most important reduction potentials of the private passenger car transportation, of the space heat sectors, of the electricity production sector, of the various industrial sectors and of electricity applications in the industrial, commercial and residential sectors. Additionally the effect of an exploitation of the potential of the renewable energy sector is investigated. Reference is the emission of the energy sector in 1987 of about 770 mill. t CO_2. The identified technical reduction potential for private passenger car transportation is about 19 mill. t CO_2/a at maximum, for the industry about 20 mill. t CO_2/a, through improvement of the efficiency of electrical appliances in the residential and commercial sector about 34 mill. t CO_2/a and for the space heat technically at least 120 mill. t CO_2/a. The exploitation of the renewable energy sector could reduce the emissions by about 31 mill. t CO_2/a and the maximum reduction through the improvement of efficiency of electricity production is about 20 mill. t CO_2/a without substitution of energy carriers. The identified CO_2-reduction options in the space heat sector and the majority of the technologies for the utilization of renewable energy sources are not economically viable at present and in the medium term. (orig./HP).

46080 (NILU-F–6/88) **NOx emissions from stationary sources in Eastern Europe. Relating NOx emission to the statistical data on fossil fuel consumption and industrial production.** Pacyna, J.M. Norsk Inst. for Luftforskning, Kjeller (Norway). Mar 1988. 19p. (CONF-8803232–1: IIASA/NILU Task Force meeting on accuracy of emmission inventories, 8-10 Mar 1988). Order Number DE89914748/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The purpose of the work is to: (1) present the NOx emission estimates from stationary sources in Eastern Europe (2) discuss the NOx emission factors used in various regional emission inventories and (3) relate NOx emissions to statistical data on the consumption of fossil fuels and the production of various industrial goods. The work is a part of a research programme on estimating the NOx emissions from anthrogenic sources in Europe, carried out at the Norwegian Institute for Air Research under contract with the Environmental Protection Agency of the Federal Republic of Germany. Reliability of the results are discussed versus external factors. 1 appendix, 7 tables, 16 references.

46081 (NUREG/CP–0098-Vol.1, pp. 409-429) **Three-part strategy for continuous extractive monitoring of hazardous particulate emissions from exhaust stacks.** Schmidt, A.C. (Schmidt Instrument Co., San Carlos, CA (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

Because of transmission losses, the customary isokinetic sampling procedures that are used for short interval aerosol sampling are not appropriate for continuous extractive monitoring of hazardous particulate emissions from exhaust stacks. A three-part strategy is described in this paper in which (1) the importance of particle size is recognized in relation to probe transmission and to the performance that is needed; (2) the sample is extracted where it will include all particle sizes that are present; and (3) transmission and entry losses are minimized by employing the latest advances in probe design and operation. Some of the points that are emphasized include: the need for specifying monitoring system performance as a function of particle size; the need for quantitative performance testing; and the need for keeping the flow in a monitoring probe constant at the flow of best transmission, and using other means, such as flow substitution, for matching the stack velocity.

46082 (NUREG/CP–0098-Vol.2, pp. 943-958) **Structural activated carbon-carbon composition media for fabrication of air and water filters.** Brassell, G.W. (Nuclear Filter Technology, Inc., Golden, CO (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

An activated structural carbon bonded carbon fiber composite exhibiting surface area values in excess of 800 m^2/g, compressive strength values of 30 to 150 psi and macro porosity (>1 micrometer) values of 65 to 95% has been developed and patented. As a result of the structural stability of the activated carbon composite, air and water filters fabricated with this media can survive overpressures caused by mishandling or a large pressure surge. The carbon composite media also will perform as a dual gas/particulate filter (adsorption of hazardous gases and entrapment of particulates). Tests performed on the media reveal that the material can be manufactured to exhibit a filtering efficiency of greater than 99.97% when DOP tested.

46083 (NUREG/CP–0098-Vol.2, pp. 959-972) **Aerosol filtration kinetics - a conceptual approach.** Jonas, L.A. (Hughes Associates, Inc., Wheaton, MD (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

In the past the study of aerosol filtration by fibrous filter mats has concentrated on the elucidation of the mechanisms of filtration, delineating the fractional contributions of diffusion, impaction, and inertia to the overall filtration efficiency. A conceptual approach is offered which would study the kinetics of aerosol filtration, concentrating on determining the aerosol filtration capacity and aerosol filtration rate constant of the filter mat. Since all physical systems can be characterized by two fundamental properties, namely a quantity factor and an intensity factor, it is expected that the filtration capacity and filtration rate constant will relate respectively to these two properties. Using the basic relationships originally derived from a continuity equation of mass balance, and a methodology analogous to that used to study the kinetics of gas adsorption, an equation was developed which should permit the determination of the aerosol filtration capacity and rate constant values for various filter mats from a series of life-thickness plots for the mats. By plotting the protective life in minutes, required to produce a chosen fractional exit to inlet aerosol penetration ratio, against the mat weight or thickness, a straight line should result from which one should be able to determine respectively the filtration capacity and filtration rate constant of the mat. The effect of superficial linear velocity on the capacity and rate constant parameters can also be determined by the same methodology. Aerosol and filter mat variations in size and type can be factored into a test program matrix to fully assess the kinetics of aerosol filtration.

46084 (NUREG/CP–0098-Vol.2, pp. 1083-1093) **Kinetics analysis of thio-alcohol on the fixed bed of activated carbon.** Kunmin, Guo (Research Institute of Chemical Defence, Beijing (China)); Cunqiao, Yuan; Lan, Ma; Yan, Wu. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

In examining the escaping vapor of thio-alcohol in pharmaceutical process, the author discusses its experimental measurement and kinetics analysis on the fixed bed of activated carbon in its cleaning process. To solve the problem of the deposit organic sulfur, gas chromatograph SP-2308 has been improved. The adsorption isotherms of thio-alcohol on five kinds of activated carbon are thus determined by chromatography, and adsorption breakthrough curves for thio-alcohol on the fixed bed of activated carbon are eventually investigated. The partition ratio of thio-alcohol on solid-gas and number of mass-transfer units of the bed can be determined under the experimental conditions by means of Model Thomas and Function Bessel. In conclusion the author reveals that the match of breakthrough curve of the thio-alcohol on the activated carbon bed and the prediction of breakthrough curve in low concentration can be satisfactorily acquired through experiments with three given parameters and the application of Model Yoon.

46085 (NUREG/CP–0098-Vol.2, pp. 1137-1143) **New 0.05 μm, 0.1 CFM optical particle counter.** Lieberman, A. (Particle Measuring Systems, Inc., Fremont, CA (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

A new optical particle counter is described that is capable of counting and sizing particles from 0.05 μm to 5 μm in diameter. The air sample flow rate is 2.8 liters per minute (0.1 CFM). Counting efficiency is 100% for particles over 0.08 μm. Coincidence counting error is less than 10% at concentrations of 3500/liter. The counter uses a high power active cavity illumination system derived from a relatively low power HeNe laser. Scattered light is collected at 90 $\pm$ 45 with a parallel array detector. Data are shown in eight size ranges in either tabular or graphical format.

46086 (NUREG/CP–0098-Vol.2, pp. 1179-1188) **Laser spectrometry technique for the determination of aerosol characteristics. Preliminary checks of the system and first results obtained.** Mazzacurati, V. (Universita "La Sapienza", Roma (Italy)); Platini, M.; Neri, E. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

A system for measuring size distribution, concentration and average velocity of aerosol particles, by means of a light scattering technique is under study in our laboratory. In its ultimate configuration, it should allow to handle concentrations up to 10^7 particles/cm^3 and particle dimensions within the 0.1 $\div$ 1.0 μm range. A preliminary study using polystyrene latex spheres (PLS) suspended in ethyl alcohol has been performed to ensure continuous laminar flow condition and controlled monodispersion. An argon-ion laser operating at 514.5 nm (TEM_{oo}) has been used. The scattering volume V_s has been defined setting the collection optics at an angle of 90° with respect to the laser beam direction. The dimensions of V_s have been selected to operate in single particle mode. Particle sizing is obtained by measuring the peak intensity of the light pulses scattered within a given acceptance angle ($I\Delta\Omega$). Preliminary results, obtained with a uniform intensity distribution realized using the reduced image of a slit illuminated by the laser beam, are presented and discussed.

46087 (OE/ARB–056-88-ARSP) **Air quality in the Sarnia area, July 1986.** Chapman, R.E.; DeBrou, G.B. Ontario Ministry of the Environment, Toronto, ON (Canada). Air Resources Branch. 1988. 42p. (MICROLOG–89-02237). Available from Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Three mobile air monitoring units (MAMUs) performed two air quality studies in the greater Sarnia area in July, 1986. The purpose of the main study was to determine the ambient air concentrations of a large number of compounds which may be emitted from industries located in Sarnia. The purpose of the secondary study was to determine if polychlorinated biphenyls (PCBs) were present in the emissions from the thermal oxidation (TOX) incinerator of the Dow

Chemical plant in Sarnia. For ease of analysis and comprehension the Sarnia area was split into five zones. The Vidal street industrial zone produced the largest 1/2-hour average concentration for most of the compounds. The Vidal, Indian Road, and Point Edward zones produced most of the highest concentrations for particular organic compouund; however, the mean concentration was larger for more compounds in the downtown Sarnia zone than in the other zones, probably due to its centralized location. On the occasions when polar organic compounds were detected and identified by the MAMU the concentrations were extremely low. During three days of monitoring near the TOX incinerator all of the measurements for total PCBs were below the MAMU detection limits of 0.13 $\mu g/m^3$ (average). The mean concentration of the total chlorinated organics measured by MAMU #2 was larger near the TOX incinerator than in the general Sarnia area. None of the common contaminants such as SO_2, NO_2, CO, total reduced sulphur, and ozone exceeded the Ontario standards or guidelines in any of the zones during the study. This also applied to the organic compounds measured. 6 figs., 12 tabs.

46088 (OE/ARB–ARB-052-87) **Mobile TAGA [trace atmospheric gas wnalyzer] survey. Sunohio molle PCB destruction facility Firestone Steel Products, London, December, 1986.** DeBrou, G.B. Ontario Ministry of the Environment, Toronto, ON (Canada). Air Resources Branch. 1987. 20p. (MICROLOG–87-03893). Available from Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

On December 9 and 10, 1986, the mobile Trace Atmospheric Gas Analyzer (TAGA) unit conducted an air monitoring survey at the Firestone Steel Products Plant in London, Ontario. The survey objective was to provide near real-time measurements of ambient polychlorinated biphenyls (PCBs) during the decontamination of three active electrical transformers containing up to 1400 ppM of PCBs. The transformers were decontaminated by Sunohio Canada using a mobile PCB destruction unit. During the 2 day survey period, a total of 225 2-minute air samples were screened for selected PCBs using the TAGA unit. None of the 15 half-hour averaged concentrations of PCBs exeeded the Ontario environment ministry guideline of 0.45 $\mu g/m^3$. In fact, all readings for ambient PCBs were below the analytical detection limits (0.07 $\mu g/m^3$), despite sampling just 0.5 metres from Sunohio's exhaust vent. 4 figs., 2 tabs.

46089 (OH/RD–88-145-K) **Sampling of polychlorinated biphenyl and volatile organic emissions from a mobile PCB destruction facility.** Curtis, K.E. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 24p. (MICROLOG–89-02554). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

As part of a provisional certificate of approval for the operation of a mobile polychlorinated biphenyl (PCB) destruction unit (MPU-1) the Ontario Ministry of the Environment required that Ontario Hydro carry out an emission testing program. Concentrations of PCB and 14 specified volatile organic compounds were to be measured both before and after the emission control device, consisting of two carbon filters in series was installed. A sampling protocol was designed and submitted to the Ministry for approval prior to the test program. Samples were collected on three consecutive days in December, 1987 and submitted for analyses. Apart from an MPU-1 system malfunction during the initial attempt to collect samples, the program was completed without any major mishaps. However, the presence of a fine oil mist in the vent gas prior to the control device has caused some problems with sample collection efficiency, analysis and the performance of the control device itself. 7 refs., 2 figs., 6 tabs.

46090 (OH/RD–88-162-K) **Emission concentration of polychlorinated biphenyls and volatile organics in the vent gas of a mobile PCB destruction facility.** Curtis, K.E. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 21p. (MICROLOG–89-02543). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An emission testing program has been carried out to determine the concentrations of polychlorinated biphenyls (PCB) and 14 volatile organic compounds in the vent gas of a mobile PCB destruction unit during the processing of an oil mixture in storage. The discovery of a fine mist of oil in the vent gas system during the operation of the unit has somewhat jeopardized the success of the test program. Its presence adversely affected the collection efficiency of the adsorption tubes used to sample some of the compounds and caused a rapid deterioration in the performance of the emission control device. This oil mist must be eliminated before the normal emissions from the process can be measured. Regardless of the above problem, only seven of the 15 compounds specified for testing were detected in the vent gas. The detection of these compounds can be attributed directly to their presence in the feed oil, and therefore the oil mist in the vent gas. This oil stock was rather unique in that it consisted of a complex misture of insulating and lubricating oils plus a variety of solvents and other volatile organic compounds. Benzene was found at the highest concentrations because it is a product of the dechlorination process. The feed oil was found to contain sufficient quantities of various chlorinated benzenes to account for the emitted benzene. PCB (in this case, Aroclor 1260) emissions were the lowest at less than 2000 ng/m^3, and would probably be even lower in the absence of the oil mist in the vent gas system. 3 refs., 19 tabs.

46091 (ORNL/TM–11065) **Soil nitrogen and ozone effects on growth, physiology, and nutrition of loblolly pine and yellow-poplar seedlings.** Tjoelker, M.G.; Luxmoore, R.J.; Schwarz, O.J. Oak Ridge National Lab., TN (USA). Jun 1989. 110p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015679/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The effects of soil nitrogen level and chronic ozone (O_3) stress on carbon and nutrient economy were investigated in loblolly pine (Pinus taeda L.) and yellow-poplar (Liriodendron tulipifera L). The objectives of the study were: (1) to compare the growth and biomass partitioning in seedlings in response to varied low-nitrogen forest soil treatments in combination with chronic ozone levels over one growing season and (2) to investigate seedling physiological responses, including water use efficiency (WUE), photosynthesis, fine root and leaf nitrate reductase activity (NRA), nutrient concentration, nutrient uptake, and nutrient use efficiency (NUE). 135 refs., 12 figs., 16 tabs.

46092 (ORNL/TM–11184) **International impacts of global climate change: Testimony to House Appropriations Subcommittee on Foreign Operations, Export Financing and Related Programs.** Fulkerson, W.; Cushman, R.M.; Marland, G.; Rayner, S. Oak Ridge National Lab., TN (USA). 21 Feb 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89014004/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

International impacts of global climate change are those for which the important consequences arise because of national sovereignty. Such impacts could be of two types: (1) migrations across national borders of people, of resources (such as agricultural productivity, or surface water, or natural ecosystems), of effluents, or of patterns of commerce; and (2) changes to the way nations use and manage their resources, particularly fossil fuels and forests, as a consequence of international concern over the global climate. Actions by a few resource-dominant nations may affect the fate of all. These two types of international impacts raise complex equity issues because one nation may perceive itself as gaining at the expense of its neighbors, or it may perceive itself as a victim of the actions of others. 11 refs., 2 figs., 1 tab.

46093 (PB–89-183032/XAB) **Mathematical modeling of cloud chemistry in the California South Coast Air Basin. Final report, August 1987-December 1988.** Seigneur, C.; Wegrecki, A.M.; Richards, L.W. Bechtel Environmental, Inc., San Francisco, CA (USA). Dec 1988. 117p. Available from NTIS, PC A06/MF A01.

The formation of sulfate and nitrate species in the California South Coast Air Basin (SoCAB) is a topic of great importance in air quality because these species lead to acid deposition, visibility

degradation, and increased aerosol concentrations. The California Air Resources Board (CARB) has sponsored several field programs over the past four years to characterize the reactants, products, kinetics and mechanisms of stratus cloud chemistry in the SoCAB. In this study, a comprehensive computerized mathematical model of cloud chemistry and physics was used to investigate the chemical and physical processes that govern the formation of acidic species in clouds. First, the performance of the model treatment of equilibrium chemistry and chemical kinetics is evaluated. Then, the model was used to investigate the chemical pathways and transport processes that lead to acid formation in clouds and to study the sensitivity of the acid concentrations to various chemical and meteorological parameters.

46094 (PB–89-183040/XAB) **Fate of hexavalent chromium in the atmosphere. Final report, January 1987-June 1988.** Grohse, P.M.; Gutknecht, W.F.; Hodson, L.; Wilson, B.M. Research Triangle Inst., Research Triangle Park, NC (USA). Oct 1988. 194p. (RTI–3798/00-01F). Available from NTIS, PC A09/MF A01.

A three-phase study was conducted to determine the fate of hexavalent chromium (Cr(VI)) in the atmosphere. Components of the study included (1) evaluation of sampling and analytical methods; (2) determination of Cr(VI) chemical pathways in the atmosphere through a series of laboratory reaction chamber tests; and (3) validation of the laboratory findings through a series of field tests. Ion chromatography utilizing photometric detection was found to be the most precise, sensitive, and rapid measurement technique. The method allowed for detection of Cr(VI) atmospheric concentrations of less than 0.1 ng/cu m. The sampling method found to provide the greatest stability of Cr(VI) during sampling utilized a 0.02M Na_2CO_3 impinger solution. Collection efficiencies exceeded 95% for this device. Laboratory studies indicated that Cr(VI) demonstrates a half life of approximately 13 hours in the presence of chemical species characteristic of atmospheres in the Los Angeles area. Actual field tests in the Los Angeles area showed a Cr(VI) half life of approximately 16 hours.

46095 (PB–89-189856/XAB) **Application guide for the source PM10 exhaust-gas recycle sampling system.** Martin, R.S.; Dawes, S.S.; Williamson, A.D.; Farthing, W.E. Southern Research Inst., Birmingham, AL (USA). Apr 1989. 151p. Available from NTIS, PC A08/MF A01.

The document describes assembly, operation, and maintenance of the Exhaust Gas Recycle (EGR) sampling system. The design of the sampling train allows the operator to maintain a constant flow rate through an inertial sampler while the gas flow rate into the sampling nozzle is adjusted to remain isokinetic with the local duct velocity. The manual specifically addresses the operation of the EGR system for determination of stationary-source PM-10 emissions. Material in the text includes: construction details, calibration procedures, presampling calculations, sample retrieval, data reduction, and equipment maintenance.

46096 (PB–89-191175/XAB) **Carbonaceous species methods comparison study: University of Minnesota results. Final report.** McMurry, P.H.; Zhang, X. Minnesota Univ., Minneapolis, MN (USA). Particle Technology Lab. Oct 1988. 60p. (PUB–668). Available from NTIS, PC A04/MF A01.

See also PB–88-175898.

The Carbon Methods Comparison Study conducted during August 12-20, 1986 at Citrus College, Glendora, CA in the Los Angeles basin compared analytical methodologies for analyzing the carbon content of aerosol samples, as well as compared measurements acquired with different samples. Five samplers, including a multistage microorifice uniform deposit impactor (MOUDI), a conventional quartz filter, a specially designed electrostatic precipitator (ESP), and 2 identical single stage MOUDIs were used. One of the single stage MOUDIs was used as a fine particle sampler; the second was used in experiments to investigate possible sampling articles. The results are summarized and discussed.

46097 (PB–89-194294/XAB) **Fiscal year 1987 summary report of NOAA (National Oceanic and Atmospheric Administration) Meteorology Division support to the environmental protection agency. Technical memo.** Viebrock, H.J.; Poole-Kober, E.M. National Oceanic and Atmospheric Administration, Silver Spring, MD (USA). Air Resources Lab. Apr 1989. 62p. (NOAA-TM-ERL-ARL–170). Available from NTIS, PC A04/MF A01.

See also report for 1986, PB–88-213624.

The Meteorology Division provided meteorological research and operational support to the U.S. Environmental Protection Agency. Basic meteorological operational support consisted of the application of dispersion models, and the conduct of dispersion studies and model evaluations.

46098 (PB–89-194864/XAB) **Capsule report: Environmental controls at a secondary lead smelter.** Schwitzgebel, K.; Vandervort, R. Radian Corp., Austin, TX (USA). Jul 1988. 24p. Available from NTIS, PC A03/MF A01.

The Environmental Protection Agency and the National Institute for Occupational Safety and Health have sponsored a study of environmental and workplace controls at a domestic secondary lead smelter. The study was intended primarily to develop information important to the effective control of environmental emissions and employee exposure. The study was carried out at East Penn Manufacturing Company in Lyons, PA. It comprised an initial baseline evaluation of environmental and workplace controls. In the followup sampling and analysis to characterize the East Penn lead smelter, the four major areas of interest were process source emissions, baghouse efficiency, employee exposure and workplace controls, and agglomeration furnace performance. Emission rates for specific lead smelting and refining operations were determined on sources hooded for emission control in the sanitary baghouse. These sources were sampled for total lead, total particle loading, and particle size distribution. Test results are reported for various sources upstream and downstream of the control systems. Employee exposures to airborne lead were reduced significantly after the control systems were in operation.

46099 (PB–89-197222/XAB) **Assessing multiple pollutant multiple source cancer risks from urban air toxics: Summary of approaches and insights from completed and ongoing urban air toxics-assessment studies.** Sullivan, D.; Lahre, T.; Alford, M. Environmental Protection Agency, Research Triangle Park, NC (USA). Office of Air Quality Planning and Standards. Apr 1989. 261p. (EPA–450/2-89/010). Available from NTIS, PC A12/MF A01.

The primary purpose of this report is to assist State, local and other agency personnel by describing methods that have been used in assessing multiple source, multiple pollutant risks from air-toxics exposures in urban areas. The report does not constitute formal EPA guidance for conducting an urban risk assessment, nor does it recommend a single approach. Instead, it identifies techniques that others have elected to employ and offers insights that may assist the reader in selecting a particular set of techniques for use in a given locale. Major topics covered include (1) a summary of completed and ongoing urban air toxics assessment studies, (2) ambient monitoring assessment approaches, (3) emission inventory/dispersion modeling assessment approaches, (4) aspects of exposure and risk assessment, (5) control strategy evaluation, (6) data handling, and (7) evolving assessment technologies, including receptor modeling, personal monitoring, and bioassay sampling.

46100 (PB–89-201859/XAB) **Acid-precipitation patterns and trends in eastern North America, 1980-1984.** Seilkop, S.K.; Finkelstein, P.L. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. 1987. 18p. (EPA–600/J-87/478). Available from NTIS, PC A03/MF A01.

Pub. in Jnl. of Climate and Applied Meteorology, Vol. 26, No. 8, 980-994(Aug 1987). See also PB–84-157932.

Using data compiled from seven nationwide precipitation-chemistry networks in the U.S. and Canada, the spatial distribution of hydrogen, sulfate, and nitrate ions in North America is discussed. Geographic patterns of concentration and deposition are characterized using isopleth maps which are presented and interpreted for the years 1980-1984. The maps were developed using a geostatistical technique known as kriging. This method allows for the estimation of confidence limits on interpolated values. Using these limits, the significance of an observed decrease in the spatial patterns of deposition and concentration is assessed. Decreases of as large as 15 to 20% were observed in sulfate and nitrate concentrations between 1980 and 1983.

46101 (PB–89-206635/XAB) **Ozone Air Quality Models: Critical Review discussion papers.** Schere, K.L. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. 1988. 9p. (EPA–600/J-88/336). Available from NTIS, PC A02/MF A01.

Pub. in Jnl. of the Air Pollution Control Association, Vol. 38, No. 9, 1114-1119(Sep 1988).

This paper is a formal response to the 1988 APCA Critical Review of Ozone Air Quality Models by Dr. John Seinfeld. His Critical Review was a comprehensive discussion on the state of knowledge of urban ozone air-quality models. The paper extends Seinfeld's review in the areas of model components and input data, emissions inventories, uncertainties in wind fields, regional scale ozone models, model evaluation, and future research directions.

46102 (PB–89-206668/XAB) **Air-pollution climatology around an isolated point source using convective scaling parameters.** Pierce, T.E. Environmental Protection Agency, Research Triangle Park, NC (USA). Atmospheric Sciences Research Lab. 1988. 15p. (EPA–600/J-88/333). Available from NTIS, PC A03/MF A01.

Pub. in Atmospheric Environment, Vol. 22, No. 11, 2463-2475(1988).

An air-pollution climatology, which incorporated convective scaling parameters, is used to investigate the conditions associated with hourly sulfur dioxide concentrations from a coal-fired power plant. One year of data from the Paradise power plant in central Kentucky (U.S.A.) was analyzed. Variables examined included emission rate, plume rise, wind speed, wind direction, stability class, convective scaling velocity, and similarity categories. The results show the meteorological conditions leading to high surface concentrations are the daytime hours having neutral/unstable atmospheric stability, light winds, and effective plume height to mixing height ratios typically greater than 0.85. In more than half of the 30 hours of highest observed concentrations, the atmospheric conditions satisfy the criteria for mixed-layer scaling.

46103 (PB–89-865711/XAB) **Asbestos: chronic health effects. September 1987-July 1989 (Citations from the Life Sciences Collection data base). Report for September 1987-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 47p. Available from NTISPC N01/MF N01.

Supersedes PB–88-867254.

This bibliography contains citations concerning laboratory and clinical studies, and case histories of chronic health effects related to asbestos. Topics include descriptions of disease progression, mortality, and survival studies, and epidemiological and immunological aspects of asbestos-related disorders. Synergistic effects with cigarette smoking are also examined. (This updated bibliography contains 94 citations, 36 of which are new entries to the previous edition.)

46104 (PB–89-865786/XAB) **Gas scrubbers used in pollution control. August 1987-July 1989 (Citations from the COMPENDEX data base). Report for August 1987-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 55p. Available from NTISPC N01/MF N01.

Supersedes PB–88-866652.

This bibliography contains citations concerning particle and gas scrubbers. Topics include design aspects, performance evaluations, gas flow analyses, and pollutant chemistry. Pollution control of SO_2, NOX, CO, CO_2, hydrocarbons, and particulates is discussed. (This updated bibliography contains 96 citations, 39 of which are new entries to the previous edition.)

46105 (PB–89-865893/XAB) **Air pollution emission factors. August 1986-July 1989 (Citations from the NTIS data base). Report for August 1986-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 88p. Available from NTISPC N01/MF N01.

Supersedes PB–88-866637.

This bibliography contains citations concerning emission factors for a variety of industrial, stationary, and mobile sources. Emissions inventories are discussed in terms of specific compounds, as well as by source type. Computer simulations utilizing emission factors in air-pollution-impact studies are also included. (This updated bibliography contains 139 citations, 56 of which are new entries to the previous edition.)

46106 (UBA-FB–89-031/1) **Standardization of the emission measurement of polycyclic aromatic hydrocarbons. Final report.** Luetzke, K.; Burk, H.D.; Kiesel, G.; Rentel, S.; Wehde, K.H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). 31 Jul 1988. 231p. (In German). Contract UFOPLAN-Nr. 10402163. Available from Copy held by UB/TIB Hannover.

A part-flow PAH emission measurements sampling system, in which the waste gas extracted from the waste gas duct is diluted by dry, purified and possibly cooled ambient air, was further developed and optimized. The aim was to be able to apply this sampling procedure to stationary installations within the context of a standardized measuring process in the meaning of the clean air regulations 'TA Luft'. The procedure characteristics were determined in accordance with the guideline VDI 2449, as were the parameters, under which PAH losses can be kept to a minimum in the sampling and analysis. In addition, measurements were carried out on various types of installations with different PAH concentrations, in the waste gas. The tests concentrated on the PAH benzo(a)pyrene and dibenz(a,h)anthracene relevant to the TA Luft. In addition to this, other PAHs were also determined and the PAH profiles were recorded in order to characterize the installations tested. For selected PAHs the reproducibilities for three different concentration ranges were determined, as were the rate of relocation and the time-based invariancy of the PAH profile in relation to the waste gas matrix (aggressive components) and on the oxidation sensitivity of the individual PAHs. The detection limit of the sampling and analysis procedure is essentially determined by the blind PAH values of the filter material. The results of the R and D project were incorporated into the draft of guideline VDI 3873. (orig.) With 44 refs., 38 tabs., 25 figs.

46107 (UBA-FB–89-031/2) **Preliminary investigations for standardizations of emission measurements of polychlorinated dibenzo-p-dioxins (PCDD) and furans (PCDF). Final report.** Luetzke, K.; Kiesel, G.; Rentel, S.; Wehde, K.H. Rheinisch-Westfaelischer Technischer Ueberwachungs-Verein e.V., Essen (Germany, F.R.). Zentralabteilung Emissionsmessungen; Umweltbundesamt, Berlin (Germany, F.R.). May 1988. 108p. (In German). Contract UFOPLAN-Nr. 10402163. Available from Copy held by UB/TIB Hannover.

The aim of research was to ascertain foundations for standardization of emission measurements of polychlorinated dibenzo-p-dioxins (PCDD) and furans (PCDF). With the LAGA method and the dilution method, this system is already in action at RWTUeV for measurement of PAH emissions (UBA-FE-project 104 02 163); double and fourfold determinations were carried out in stack gas of one municipal waste incineration plant. Stack gas samples taken at the same time and by two sampling apparatures of the same kind give approximately equal or similar PCDD/PCDF emission concentrations and isomer distribution patterns. The PCDD/PCDF emission concentrations and the recoveries found by the dilution method are three to nine times higher. The dilution method as compared with the LAGA method, has the following advantages: isokinetic suction, over 98% separation on the first filter, avoidance of thermal, chemical and catalytic reactions as a consequence of dilution and cooling at 40^0C, no problems with purification of the measuring apparatus, measurements in horizontal and vertical axis. (orig.) With 18 refs., 46 tabs., 23 figs.

46108 (UCRL–21199) **Wind-tunnel study of atmospheric dispersion of exhausts from the NDERF building stack.** Stein, W.; White, B.R.; Kavanagh, J.; Brucker, D.; Castro, E.; Bagheri, N.; Strataridakis, C.J. Lawrence Livermore National Lab., CA (USA). Jan 1989. 46p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89016510/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The dispersion of trace amounts of gases or particles from the stack of the NDERF building at Lawrence Livermore National Laboratory was investigated by conducting scaled experiments in an atmospheric wind tunnel. The stack is 35m tall and is located in a

suburban-type setting near two- and three-story buildings and medium-height trees. The wind-tunnel boundary layer was representative of a slightly unstable atmosphere with velocity and turbulence intensity profiles comparable to those in full scale at the Laboratory. Wind-tunnel tests consisted of releasing an ethane tracer gas from the stack in the tunnel and measuring ground-level concentration profiles and vertical concentration profiles. Tests were conducted for conditions representative of wind speeds of 7 mph and for north, west, and east wind directions. Smoke tracer tests were also conducted to visually show the shape of the dispersing plume. Results of the smoke tests show that the dispersing plume makes contact with the building's roof air intakes. Results of the dispersion experiments show values of peak ground-level concentrations generally occurring 600m downstream of the stack. Wind-tunnel ground-level concentrations show close agreement with those predicted by Gaussian dispersion models. 8 refs., 22 figs., 2 tabs.

46109 (UCRL–21200) **Wind-tunnel study of atmospheric dispersion of exhausts from the stack of building 222.** Stein, W.; White, B.R.; Kavanagh, J.; Brucker, D.; Castro, E.; Bagheri, N.; Strataridakis, C.J. Lawrence Livermore National Lab., CA (USA). Jan 1989. 76p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89016520/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

The dispersion of trace amounts of gases and particles from the stack of Building 222 at Lawrence Livermore National Laboratory was investigated by conducting scaled experiments in an atmospheric wind tunnel. The stack is 28m tall and is located in a suburban-type setting surrounded by two- and three-story buildings and medium- height trees. The wind-tunnel boundary layer was representative of a slightly unstable atmosphere with velocity and turbulence intensity profiles comparable to those in full scale at the Laboratory. Wind-tunnel tests consisted of releasing an ethane tracer gas from the stack in the tunnel and measuring horizontal and vertical concentration profiles as well as ground-level concentration profiles to distances of 600m from the stack. Tests were conducted for conditions representative of wind speeds of 6 mph and 11 mph at the stack height and for nine different wind directions. Smoke tracer tests were conducted to show air-flow streamlines, and wake effects and recirculation zones caused by nearby tree and building obstructions. Results of the smoke tests show that recirculation zones do not envelope the top of the stack. However, they also show that the wake of nearby trees or a wake caused by the upwind edge of the building does extend to heights above the stack. Results of the ground-level concentration measurements show values that agree favorably with those predicted by Gaussian dispersion models. The wind-tunnel results also were favorably compared to a full-scale case for which ground-level concentration data were available. 9 refs., 50 figs., 2 tabs.

46110 (UCRL–50007-87, pp. 57-61) **Evaluation of four models of personal air samplers.** Boyer, J.F.; Held, B.J. Lawrence Livermore National Lab., CA (USA). Jul 1988. In *Hazards Control Department annual technology review, 1987.* Order Number DE89002470/JAW. Available from NTIS, PC A07/MF A01.

The authors evaluated four makes of personal air samplers to determine which would best serve particular needs of field industrial hygienists and health technicians. The four makes of personal air samplers we studied are the duPont Alpha-1, the Gilian HFS 113A (UT), the MSA Flow-Lite, and the Sensidyne BDX 60. The tables in this report list the physical characteristics of each sampler and also give the results of the laboratory evaluations of each sampler's operating characteristics. The authors measured the noise levels generated by each sampler and inspected the required maintenance procedures. They also determined how long the pumps would operate without recharging or undergoing a change in flow rates and noise levels. With this information, field personnel should be able to choose the sampler that best fits the needs of a particular operation.

5003 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 45009, 45117, 45118, 45119, 45120, 45121, 45122, 45123, 45124, 45125, 45365, 45626, 45988, 46002, 46081, 46082, 46083, 46085, 46086

46111 (EUR–11755, pp. 36-57) **Aerosol metrology: aerodynamic and electrostatic techniques.** Prodi, V. (Bologna Univ. (IT). Ist. di Fisica). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Aerosols play an ever increasing role in science, engineering and especially in industrial and environmental hygiene. They are being studied since a long time, but only recently the progress in aerosol instrumentation has made it possible to pose of aerosol metrology, especially the problem of absolute measurements, as based directly on measurements of fundamental quantities. On the basis of absolute measurements, the hierarchy of standards can be prepared and adequately disseminated. In the aerosol field, the quantities to be measured are mainly size, charge, density, and shape. In this paper a possible standardisation framework for aerosols is proposed, for the main physical quantities.

46112 (EUR–11755, pp. 58-84) **Virtual cascade impactors for the collection of radioactive atmospheric aerosols.** Berner, A. (Vienna Univ. (AT). Inst. fuer Experimentalphysik). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Starting from impaction theory, the properties of virtual impaction stages are discussed and compared to classical impactors. Virtual impaction stages offer the benefit of sampling coarse particles without bouncing and reentrainment, but turbulent mixing affects the performance of virtual stages. Future research should concentrate on special configurations for reducing the effects of turbulent mixing. Virtual impaction stages for sampling radioactive aerosols are to be designed in regard of the analytical requirements, the purpose of the measurements, and the aerosol. Therefore, the aerosol components expected in radioactive aerosols are discussed on the background of the multimodal model, which relates the size distribution to the genesis and the history of the aerosol. Reference is made to recent data of the radioactive atmospheric aerosol.

46113 (EUR–11755, pp. 85-92) **New inertial and diffusional device (SDI 2000).** Boulaud, D. (CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (FR). Inst. de Protection et de Surete Nucleaire); Diouri, M.; Oujda Univ. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8712146–: Experts' meeting, 3-4 Dec 1987). In *Aerosol measurements and nuclear accidents: A reconsideration.* Order Number DE89908161/JAW. Available from NTIS (US Sales Only), PC A08/MF A01.

Our aim has been to develop a new diffusional and Inertial Spectrometer (SDI 2000) able to cover a 2000-fold size range from 0.0075 μm to 15 μm and also to provide a mass size distribution corresponding to the true aerodynamic behavior of the aerosol measured. For this we chose to characterize aerosol inertial behavior for sizes sizes greater than 0.3 μm and aerosol diffusional behavior for sizes less than 0.3 μm. To achieve this, we combined in series a cascade impactor and a diffusion battery consisting of tubes arranged in parallel. The first step in analyzing mass size distribution of an aerosol involves inertial selection by collecting deposits at different stages of the impactor. The second step is a diffusional selection performed by collecting the deposits on filters placed downstream from the tubes where the aerosol is diffused through beds of glass beads.

46114 (NSS/R–137) **Studies of climatic effects relevant to site selection and to assessments of the radiological impact of disposal at selected sites.** Goodess, C.M.; Palutikof, J.P.; Davies, T.D. United Kingdom Nirex, Ltd., Harwell (UK). Jul 1988. 418p.

(HL–89/1528). Order Number DE89636295/JAW. Available from NTIS (US Sales Only), PC A18/MF A01 - OSTI; INIS.

Projected timescales for the transport of radionuclides from an undisturbed underground nuclear waste repository to the surface are in the range of tens of thousands to millions of years. Over these timescales major natural and anthropogenic changes in climate can be expected. As part of the UK safety assessment programme time-dependent models of the repository environment are being developed and the Climatic Research Unit (CRU) has undertaken a study of relevant climatic change and climatic effects. In order to estimate the probable range succession and duration of major climate states likely to be experienced in the UK over the next 10^6 years the nature and mechanisms of climatic variations in the past are first reviewed. (Author).

46115 (NUREG/CP–0098-Vol.1, pp. 116-136) **Airborne concentrations of radioactive materials in severe accidents.** Ross, D.F. Jr. (Nuclear Regulatory Commission, Washington, DC (USA)); Denning, R.S. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

Radioactive materials would be released to the containment building of a commercial nuclear reactor during each of the stages of a severe accident. Results of analyses of two accident sequences are used to illustrate the magnitudes of these sources of radioactive materials, the resulting airborne mass concentrations, the characteristics of the airborne aerosols, the potential for vapor forms of radioactive materials, the effectiveness of engineered safety features in reducing airborne concentrations, and the release of radioactive materials to the environment. Ability to predict transport and deposition of radioactive materials is important to assessing the performance of containment safety features in severe accidents and in the development of accident management procedures to reduce the consequences of severe accidents.

46116 (NUREG/CP–0098-Vol.1, pp. 512-523) **Kinetic studies of the retention of radioactive gases by activated carbon adsorbers.** Friedrich, V. (Institute of Isotopes, Budapest (Hungary)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.1: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 1–5.* Order Number DE89014647/JAW. Available from NTIS, PC A99/MF A01 - I.

A bimolecular reaction model containing the physico-chemical parameters of the adsorption process has been developed to describe the kinetics of a continuously operating adsorption column. An analytical solution of the model was found for low inlet gas concentrations and a cascade-type numerical method was used for calculations at higher inlet concentrations. When calculating accumulation and break-through curves using the cascade method the results show a strong concentration dependence at higher inlet concentrations but with decreasing concentration the curves asymptotically tend to the curve calculated by the analytical solution which is not concentration-dependent. Adsorption and desorption rate constants (K_F and K_B) and active site concentration (A_o) were determined by fitting theoretical curves on experimentally measured break-through curves. The values of K_F, K_B, and A_o were $3x10^3$ cm^3 mol^{-1} s^{-1}, $2.5x10^{-4}$ s^{-1} and $2.3x10^{-3}$ mol cm^{-3}, respectively, for the system composed of methyl-iodine vapor as adsorbate and granuled activated carbon as adsorbent. Adsorption isotherms measured under dynamic conditions and at various temperatures were of Langmuir-type. From the temperature-dependence of the kinetic parameters the activation energy was calculated by the help of the Arrhenius-equation and the process was found exotherm with an activation energy of 67 KJ mol^{-1} (16 kcal mol^{-1}).

46117 (NUREG/CP–0098-Vol.2, pp. 847-856) **Development, performance, and application of an advanced isokinetic stack sampling system.** Kurz, J.L. (Kurz Instruments Inc., Monterey, CA (USA)); Ramey, T.C. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

Substantial improvements in particulate isokinetic sample collection have been achieved. The paper has four major sections. First, unique thermal mass flow sensor technology indispensable to a high performance, continuous and automatic isokinetic sampling is introduced. Secondly, new sample nozzle design practices are discussed. Thirdly, empirical particle loss test results of ANSI-13.1 sample nozzles versus Kurz sample nozzles are published, and discussed. Finally, new particle loss calculation software useful in the design of sample withdrawal nozzles and manifolds is discussed. The authors conclude that existing DOE, NRC, EPA, ANSI, ASME, specifications for sampling nozzles are deficient, and suggest that new specifications be based on particle loss performance, i.e. nozzle shall successfully collect 30% of 15 micron particles, etc.

46118 (NUREG/CP–0098-Vol.2, pp. 879-895) **Catalytic oxidation of tritium and tritiated hydrocarbons in air and argon and adsorption of tritiated water on type 3A molecular sieves.** Qidong, Li (Fudan Univ., Shanghai (China)); Shungquing, Yuan; Changzhou, Ye; Kuidong, Zhoa; Ruihua, Xi; Bokang, Wu; Zuoshi, Liu. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

For the tritium removal system using catalytic oxidation, an efficient catalyst was developed at Fudan University. Several dozens of catalysts prepared in our laboratory have been tested and 0.6% Pd/Al_2O_3 catalyst was found to be the most promising one. This catalyst can give a quite satisfactory decontamination factor when operated at 160°C for ^3H in air, and at 400°C for tritiated hydrocarbons. Permissible discharge concentration can be achieved when the tritium-air gas mixture passes through the catalyst bed only once. The catalytic kinetic characteristics have been studied. Such as, fractional conversion, reaction order, reaction rate coefficient, activation energy, etc. In addition, adsorption dynamics of the 3A molecular sieve was studied. In the test, tritiated water vapor was used as the inlet gas. The result shows that the adsorption capacity was found to be 7.1 m mole/me (0.14g tritiated water vapor /g molecular sieve); the maximum adsorption capacity is dependent on temperature but not on flow velocity. And the result shows also that the adsorption mechanism of type 3A molecular sieve is an isotopic exchange process of H/T and the dryness of molecular sieve has no effect on adsorption capacity.

46119 (NUREG/CP–0098-Vol.2, pp. 973-983) **General correlation of DOP penetration with face velocity as a function of particle size using the FTS-200.** Pierce, M. (Hollingsworth and Vose Company, West Groton, MA (USA)); Guimond, R.; Lifshutz, N. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The FTS-200 is a flat media filtration test stand build by TSI, Inc. of St. Paul, Minnesota. The test stand incorporates: (1) aerosol generation by atomization and evaporation techniques, (2) particle size selection by electrostatic classification and, (3) particle counting using a condensation nucleus counter (CNC). The stand is capable of accurately determining filtration efficiencies as high as 99.99999% for narrow particle size fractions in the diameter range of 0.05 to 0.4 microns. In addition, it measures the pressure drop across the flat media samples at accurately determined face velocities ranging from 0.5 to 15.0 cm/sec. A study was carried out measuring DOP penetration on a broad series of flat filtration media samples at various particle sizes and face velocities. The sampling

consisted of both commercial HEPA and ULPA media as well as binderless handsheets prepared from individual grades of microfiber glass. The effects of face velocity on the most penetrating particle size were studied. In this paper we present a useful correlation between DOP penetration and relative face velocity, utilizing particle size as a parameter. Similar correlations relating 'alpha' and 'figure of merit' rating to relative face velocity are described. Finally, we explore the use of these correlations as predictors of DOP penetration and most penetrating particle size at application face velocities, and their impact on filter design and media selection.

46120 (NUREG/CP–0098-Vol.2, pp. 1109-1116) **Multitubular option in adsorbent carbon filter unit design.** Fielding, G. (Hughes Associates, Inc., Wheaton, MD (USA)). Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The design and performance characteristics are calculated and compared for monotubular, multitubular, and flat-bed adsorbent carbon filter units. A pentatubular unit appears to have outstanding characteristics.

46121 (NUREG/CP–0098-Vol.2, pp. 1284-1295) **Fire source term modeling using the FIRIN code.** Ballinger, M.Y. (Pacific Northwest Laboratory, Richland, WA (USA)); Owczarski, P.C. Nuclear Regulatory Commission, Washington, DC (USA). Office of Nuclear Regulatory Research; Harvard Univ., Boston, MA (USA). Harvard Air Cleaning Lab. May 1989. DOE Contract AC06-76RL01830. (CONF-880815–Vol.2: 20. DOE/NRC nuclear air cleaning conference, 22-25 Aug 1988). In *Proceedings of the 20th DOE/NRC nuclear air cleaning conference. Sessions 6–15.* Order Number DE89014648/JAW. Available from NTIS, PC A99/MF A01 - I.

The source term, or amount of radioactive material that challenges the air cleaning components during potential accidents in nuclear fuel cycle facilities, must be estimated to calculate the release of contaminants to the environment. The US Nuclear Regulatory Commission has sponsored a research program to better estimate the source term from several types of accidents. The most concentrated work has been done on fires, resulting in the development of FIRIN, a compartment fire code that estimates the release and distribution of radioactive materials within a room from fires involving radioactive materials. FIRIN relies on a set of subroutines to calculate quantity and size distribution of airborne radioactive material during a fire. These subroutines are identified with mechanisms of release such as pressurized releases of heated containers of radioactive materials or burning of contaminated combustibles. The main body of the code supplies factors that influence the source term to these subroutines. Examples of parameters supplied are fire burn rate, combustion product generation, heat and mass transfer, and fluid flow parameters. The code also takes into account depletion of airborne particles resulting from gravity settling, Brownian diffusion, diffusiophoresis, and thermophoresis.

5005 Site Resource and Use Studies

46122 (EGG–2564) **Environmental monitoring for EG and G Idaho facilities at at the Idaho National Engineering Laboratory: Annual report, 1988.** Tkachyk, J.W.; Wright, K.C.; Ritter, P.D.; Wilhelmsen, R.N.; Heileson, W.M. EG and G Idaho, Inc., Idaho Falls, ID (USA). Aug 1989. 65p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89015210/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report describes the 1988 environmental monitoring activities of the Environmental Monitoring Unit of EG and G-operated facilities at the Idaho National Engineering Laboratory (INEL). The major facilities monitored include the Radioactive Waste Management Complex, the Waste Experimental Reduction Facility, the Mixed Waste Storage Facility, and two surplus facilities. Additional monitoring activities performed by Environmental Monitoring are also discussed, including preliminary radiological characterization of other facilities, drinking water monitoring, nonradiological liquid effluent monitoring, subsurface investigations, and data management. The primary purposes of monitoring are to evaluate environmental conditions and to provide information, in compliance with applicable regulations and interpreted as necessary, for ensuring protection of personnel, the public, and the environment. This report also compares 1988 environmental monitoring data with derived concentration guides and with data from previous years. This report also presents selected results of sampling performed by the Radiological and Environmental Sciences Laboratory and by the United States Geological Survey. 24 refs., 48 figs., 15 tabs.

5006 Regulations

Refer also to citation(s) 44826, 46079, 46138, 46139

51 ENVIRONMENTAL SCIENCES, TERRESTRIAL

Refer also to citation(s) 46198

5101 Basic Studies

Refer also to citation(s) 44659, 46062, 46067

46123 (ETDE/CA-MS–102) **The common eider (Somateria mollissima sedentaria) of eastern Hudson Bay. A survey of nest colonies and Inuit ecological knowledge.** Nakashima, D.J.; Murray, D.J. Department of Energy, Mines and Resources, Ottawa, ON (Canada). 1988. V (MICROLOG–89-02451). Available from Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In response to the threat posed by oil exploration in central Hudson Bay, this study was designed to provide information on the numbers, breeding distribution and ecology of common eiders in the eastern part of the Bay. The east shore of the Bay is of particular concern as the prevailing west and northwest winds render it the most susceptible to oil damage. The results of this study establish a quantitative basis for monitoring the eider population and provide baseline ecological information for appropriate oil spill response planning. Seven subregions were selected for intensive ground surveys, three in nearshore archipelagos and four in the offshore. From the results, the estimated size of the breeding population of the Hudson Bay eider, from the Akulivik area in the north to the junction of Hudson and James Bays in the south, to be about 41,490 breeding pairs. Although there are some indications that the breeding population may have declined in some nearshore areas, it appears that as a whole the sedentaria population is healthy and stable. Data on the eider's ecology were collected during interviews with 41 Inuit from local communities. Extensive information was compiled on eider taxonomy, biogeography, behavior, diet, life history, and breeding and wintering ecology. 35 refs., 21 figs., 14 tabs.

46124 (INIS-mf–11490) **Proceedings of the national workshop on the use of ^{137}Cs to measure erosion.** Soil Conservation Service of New South Wales, Sydney (Australia). Jan 1989. 24p. (CONF-8809383–: National workshop on the use of ^{137}Cs to measure erosion, 20 Sep 1988). Order Number DE89635091/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The workshop was concerned with the use and development of Cs-137 techniques of measuring erosion. The overall outcome of the workshop was a view that it is inappropriate at this time to conduct a comprehensive national assessment of soil erosion using the Caesium-137 technique, but it is appropriate to conduct a reconnaissance survey which would establish/confirm reference levels of Cs^{137} deposition across Australia, establish, at a statistically viable level, the capability to confirm at least large differences in Cs^{137} concentration, and build up a more comprehensive picture of Cs^{137} and its association with soil movement in the Australian landscape.

46125 (INIS-mf–11490, pp. 4) **Cs-137 activity as an index of soil movement under a grazed native pasture at Narayen,**

Queensland. Bridge, B.J. (Commonwealth Scientific and Industrial Research Organization, Toowoomba (Australia). Queensland Wheat Research Institute); O'Leary, B.M.; Mott, J.J. Soil Conservation Service of New South Wales, Sydney (Australia). Jan 1989. (CONF-8809383--: National workshop on the use of ^{137}Cs to measure erosion, 20 Sep 1988). In *Proceedings of the national workshop on the use of ^{137}Cs to measure erosion.* Order Number DE89635091/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Cs-137 measurements for the 0-10 cm soil depth are presented, together with the paddock slope profile. The trend for lower activities in the region of maximum slope and the high activity at the bottom of the slope is apparent. However, the variability is considerable and this makes quantitative assessment difficult. The study used a Li-drifted Ge 12% detector which allowed only one sample per day to be counted. This is a major problem with the Cs-137 technique.

46126 (INIS-mf--11490, pp. 4) **Using Cs-137 to assess sheet erosion in Western Australia.** McFarlane, D.J. (Western Australia Dept. of Agriculture, Perth (Australia). Div. of Water Resource Management); Loughran, R.J.; Campbell, B.L. Soil Conservation Service of New South Wales, Sydney (Australia). Jan 1989. (CONF-8809383--: National workshop on the use of ^{137}Cs to measure erosion, 20 Sep 1988). In *Proceedings of the national workshop on the use of ^{137}Cs to measure erosion.* Order Number DE89635091/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Cs-137 technique represents the only feasible method whereby sheet erosion is likely to be measured in Western Australia given the expense of building, equipping and monitoring stream gauging stations and the difficulties in detecting small but significant changes in soil levels on sites subject to wind erosion. A pilot study in 1987 used a stratified sampling technique to assess sheet erosion on representative hillslopes. There are possible problems in using the Cs-137 technique in Western Australia due to poor labelling of non-wetting soils, due to poor retention by very sandy soils, due to the selective removal of dust particles and due to wind erosion adding Cs-137 to input sites. Lateritic gravel stones may also need to be crushed and added to the samples for analysis. Some of these problems may be better understood when the results of the pilot survey have been analysed.

46127 (INIS-mf--11490, pp. 2) **Variability of caesium-137 in soils.** Perrens, S.J. (Dames and Moore, Sydney (Australia)); Norris, V. Soil Conservation Service of New South Wales, Sydney (Australia). Jan 1989. (CONF-8809383--: National workshop on the use of ^{137}Cs to measure erosion, 20 Sep 1988). In *Proceedings of the national workshop on the use of ^{137}Cs to measure erosion.* Order Number DE89635091/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A study was undertaken to assess the variability of ^{137}Cs in a red-brown earth, located 10 kilometres north-east of North Star, northern NSW, in gently undulating dryland farming country. Caesium-137 was determined by gamma spectroscopy using a Ge-Li detector and multi-channel analyser. The requirement for taking and analysing large numbers of samples in order to obtain sufficient confidence in estimates of erosion rate poses a serious limitation on the widespread use of ^{137}Cs measurement for this purpose.

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Refer also to citation(s) 44771, 44782, 44783, 44796, 44809, 46071, 46169

46128 (AD-A--207706/3/XAB) **Ox Mountain sanitary landfill: Apanolio Canyon expansion site, San Mateo County, California. Volume 1. Final EIS (Environmental Impact Statement) and response to comments. Final report.** Harding-Lawson Associates, Novato, CA (USA). Apr 1989. 503p. Available from NTIS, PC A22/MF A01.

See also Volume 2, AD-A207-707.

Contents include: summary; introduction; proposed action and alternatives; affected environment; geology, soils and seismicity; hydrology and water quality; biology; transportation and circulation; air quality; noise; public health and safety; public facilities and services; cultural resources; aesthetics; land use plans and policies; economics; environmental consequences: geology-soils and -seismicity; hydrology and water quality; biology; transportation; air quality; noise; public health and safety; public facilities and services; cultural resources; aesthetics; land use plans and policies; economics; cumulative impacts; unavoidable adverse impacts; short-term uses vs. long-term productivity; irreversible/irretrievable commitments of resources; consultation and coordination; references; list of preparers; draft eis review; index.

46129 (CONF-881054--Vol.1, pp. 117-127) **Use of cone penetration systems for remedial investigation of waste sites.** Taylor, L.R. (Earth Technology Corp. (USA)); Berzins, N. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

The Cone Penetration Test (CPT) and other in situ tests and sampling approaches related to the basic CPT have been used during site characterization studies and remedial investigations at waste sites. In addition to deploying standard electronic cone penetrometers, CPT systems can be used to deploy a wide variety of other in situ testing devices and sampling probes to gather subsurface information at waste sites. The use of these tools can provide a safe, efficient and cost-effective means of assessing a broad range of subsurface soil and contaminant conditions including stratigraphy, soil types, engineering properties, contaminant migration and hydrogeologic conditions. This paper presents a description and discussion of the use of electronic friction-cone penetrometers and other in situ testing tools including self-grouting cone penetrometers, soil gas sampling probes, groundwater sampling probes and other devices. The benefits of utilizing CPT-based techniques during the initial stages of RIs are discussed with respect to cost, productivity, health and safety concerns, and quality of data.

46130 (CONF-881054--Vol.2, pp. 385-396) **Case history: Air Force base jet fuel spill remedial investigation, feasibility study, and remedial design.** McIntyre, G.T.; McElroy, W.J. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

In May 1982, Air Force base personnel discovered JP-4 fuel leaking from an underground purge line near Pump Station 9. Installation Restoration Program (IRP) investigations in November 1984 confirmed JP-4 was floating on the water table in an area now identified as Site 9. In May 1986, work was initiated under the Martin Marietta Energy Systems Hazardous Waste Remedial Action Program for a remedial investigation/feasibility study (RI/FS) to culminate in the selection and conceptual design of remedial action for the area. The RI involved the installation of 13 shallow borings and temporary well points to evaluate the location and extent of the floating JP-4 plume. Four shallow and two deep monitor wells were installed to evaluate the location, extent, and magnitude of dissolved hydrocarbon contamination. Also included in the RI were ground water, soil, surface water, sediment, and JP-4 fingerprinting sampling. The RI located a floating JP-4 plume covering approximately 2 acres and a dissolved hydrocarbon plume. FS preparation progressed in a series of IRP-required stages. Control measures screened for feasibility and applicability were used to develop remedial action alternatives. Evaluation of detailed alternatives encompassed engineering feasibility, public health impacts, environmental effects, regulatory requirements, and present worth costs. The remedial action selected includes JP-4 and ground water recovery by two wells fitted with dual pumping recovery systems, ground water treatment by air stripping, discharge of treated ground water through an onsite infiltration trench, and collection and management of recovered JP-4. The final design is underway and will be completed in October 1988.

46131 (CONF-881054--Vol.2, pp. 575-586) **Evaluation of methyl ethyl ketone (2-butanone) contamination at the Massachusetts Military Reservation.** Haase, C.S. (E. C. Jordan Co., Oak Ridge, TN (USA)); Wallin, B.K.; Miller, M.S. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak

Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

Methyl ethyl ketone (MEK or 2-butanone) has been found in a majority of wells installed in the Mashpee Study Area as part of the Task 5 (Mashpee Groundwater Study) Installation Restoration Program activities at the Massachusetts Military Reservation, Cape Cod, Massachusetts. The concentration and occurrence of MEK within the wells of the study area, however, exhibit significant spatial and temporal variability for six sampling rounds conducted between May 1987 and February 1988. Correlation of MEK occurrence and concentrations for repeat samplings from wells is typically poor. Such observations have raised the question as to whether MEK is actually present in groundwater at the Mashpee Study Area. Data validation, quality assurance/quality control audits, special samplings using modified techniques, and review and modification of analytical methods for MEK have been undertaken to evaluate the MEK data. Results from these activities suggest that much, if not all, of the MEK occurrences detected in ground waters within the study area may be false positives. Such false positives could have resulted from (1) possible contamination during sample collection, (2) possible laboratory contamination, and (3) inherent lack of sensitivity for MEK in the analytical techniques employed.

46132 (CONF-881054–Vol.2, pp. 587-598) **Multi-faceted approach to site characterization at Volk Field ANGB (Air National Guard Base).** Bonner, R.S. (Engineering-Science, Inc. (USA)); Duncan, W.J. Martin Marietta Energy Systems, Inc., Oak Ridge, TN (USA); Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 2.* Order Number DE89014701/JAW. Available from NTIS, PC A13/MF A01.

Eight sites at Volf Field Air National Guard Base (ANGB), Camp Douglas, WI and affiliated Hardwood Range were identified as being, or potentially being, sources of environmental contamination. These facilities are located in South Central Wisconsin within an area known as the driftless zone. The base is no gently undulating land surrounding sandstone buttes. The sites are underlain by unconsolidated sands and clays (Pleistocene lake deposits) and sandstones (Cambrian). The sites include one bulk fuels storage area, one PCB disposal area, one munitions disposal area, three former landfills and a fire training area. The multi-faceted approach used to conduct the investigations included soil-gas surveys, geophysical surveys, soil sampling and analysis, ground and surface water analyses, slug tests and an aquifer pumping test. The work at the Fire Training Area provides an opportunity to illustrate the usefulness of multiple techniques in performing a remedial investigation. A soil-gas survey delineated an area of probable solvent and fuel contamination. Drilling and monitoring well installation verified the presence of contaminants and indicated that ground water was contaminated with trichloroethylene, benzene, toluene, and xylenes beyond the plume boundary estimated by the soil-gas survey. Slug and aquifer tests were conducted to evaluate aquifer properties. The work to date tentatively identified the need for additional studies to characterize the extent of contamination at this and five other sites.

46133 (CONF-8907123–1) **Direct sampling ion trap mass spectrometry for the rapid determination of volatile organics in environmental matrices.** Buchanan, M.V.; Wise, M.B.; Guerin, M.R. Oak Ridge National Lab., TN (USA). [1989]. 10p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From EPA waste testing and quality assurance symposium; 24-28 Jul 1989. Order Number DE89015358/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Analytical methods are currently being developed for the rapid determination of part-per-billion or lower levels of volatile organics in water, soil, air, and oil samples using direct sampling in combination with a rf quadrupole ion trap mass spectrometer (ITMS). Features of the ITMS which are important to the success of these applications include the ability to perform selective chemical ionization, high efficiency collision induced dissociation (MS/MS) experiments, excellent instrument reliability and tolerance to relatively high operating pressures. Excellent detection limits, linearity of response, and reproducibility have been demonstrated for the determination of volatiles in water, soil, and air. Because no chromatography is used, sample turn-around is typically less than 5 minutes. Direct sampling is accomplished with a split-open-split capillary restrictor interface which has been designed to accept a wide variety of sampling devices. Volatiles in water can be determined without any sample preparation simply by direct purge with helium into the mass spectrometer sample interface. A helium flow rate of approximately 100 ml/min through a sparging device enables reproducible purging of volatiles from a 15 ml water sample in less than 3 minutes. Soil samples are prepared by adding 15 ml of distilled water to 5 g of soil to form a slurry. Chlorinated solvents have been successfully purged from samples of used motor oil without any sample preparation. Volatile organics in air may be determined either by direct sampling or by preconcentration on a resin trap followed by direct thermal desorption into the ITMS. Direct air sampling has an estimated detection limit of approximately 1 ppB, while preconcentration is effective for ppT or lower levels of constituents. 5 figs.

46134 (CONF-8909170–1) **Environmental and plant effects of sewage sludge application to forests and pastures.** Van Miegroet, H.; Boston, H.L.; Johnson, D.W. Oak Ridge National Lab., TN (USA). [1989]. 27p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From 12. annual Madison waste conference; 20-21 Sep 1989. Order Number DE89015896/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Digested sewage sludge was applied to pastures and tree plantations at 19 to 44 Mg/ha (dry weight) as part of a municipal sludge disposal program. The sludge had low concentrations of heavy metals and traces of ^{137}Cs and ^{60}Co. Monitoring of soils, soil solutions, and runoff indicated that N, P, heavy metals, and radionuclides were largely retained in the upper 15cm of the soil. Soil solutions had elevated NO_3^- concentrations often >100 mg/L, but no significant increases in groundwater NO_3^- were found during the first year. Runoff from active sites had elevated concentrations of NO_3^- (20–30 mg/L), soluble P (1 mg/L), BOD_5 (5–30 mg/L), and fecal coliform (up to 14,000 colonies per 100 ml), not unlike runoff from pastures with cattle. Enrichment of organic N (2 times), available (inorganic) N (5 to 10 times), and Bray-P in the upper soils persisted for several years following sludge application. Sludge increased vegetation N concentrations from 1.5% to 2.3% and P concentrations from 0.16% to 0.31%. With the exception of Zn, heavy metals did not accumulate substantially in the vegetation. The sludge addition increased the survival and growth of sycamore (Platanus occidentalis L.). For a loblolly pine (Pinus taeda L.) plantation future growth improvements are expected based on elevated foliar N concentrations. 37 refs., 3 figs., 7 tabs.

46135 (CPS–EPS9/HA/1) **Manual for the management of wastes containing polychlorinated biphenyls (PCBs).** Environment Canada, Ottawa, ON (Canada). Conservation and Protection. 1987. 93p. (MICROLOG–87-02651). Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This manual presents recommended practices for the management of wastes containing polychlorinated biphenyls (PCBs). It covers procedures for decommissioning and decontamination, storage, transportation, disposal, labelling and recordkeeping, and emergency preparedness for PCB-contaminated equipment and containers, as well as for solid and liquid wastes containing more than 50 ppM of PCBs. Summaries of Canadian federal and provincial regulations, and requirements for incineration and for high efficiency boilers, are also included. 18 refs., 9 figs., 4 tabs.

46136 (CPS–SPE9/HA/1) **Manual for the management of wastes containing polychlorinated biphenyls (PCBs).** Environment Canada, Ottawa, ON (Canada). Conservation and Protection. 1987. 94p. (In French). (MICROLOG–87-02652). Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

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covers procedures for decommissioning and decontamination, storage, transportation, disposal, labelling and recordkeeping, and emergency preparedness for PCB-contaminated equipment and containers, as well as for solid and liquid wastes containing more than 50 ppM of PCBs. Summaries of Canadian federal and provincial regulations, and requirements for incineration and for high efficiency boilers, are also included. 18 refs., 9 figs., 4 tabs.

46137 (DOE/RL–89-11) **Toxic chemical release inventory: Superfund Amendments Reauthorization Act, Title 3, Section 313.** USDOE Richland Operations Office, WA (USA). Jul 1989. 79p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. Order Number DE89016244/JAW. Available from NTIS, PC A05/MF A01 - OSTI.

Toxic chemical release information contained in this document was derived using process flow diagrams and material balances, process chemistry and emissions treatment technology, hazardous materials inventories, environmental permits, hazardous materials release reports, hazardous waste shipment papers, and sample analysis or monitoring data where available.

46138 (ORNL–6526/R5) **Environmental Regulatory Update Table, June 1989.** Houlberg, L.M.; Langston, M.E.; Nikbakht, A.; Salk, M.S. Oak Ridge National Lab., TN (USA). Jul 1989. 103p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015683/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Environmental Sciences Division Publication No. 3248.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

46139 (ORNL–6526/R6) **Environmental Regulatory Update Table, July 1989.** Houlberg, L.M.; Langston, M.E.; Nikbakht, A.; Salk, M.S. Oak Ridge National Lab., TN (USA). Aug 1989. 105p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE89015684/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

Environmental Sciences Division Publication No. 3248.

The Environmental Regulatory Update Table provides information on regulatory initiatives of interest to DOE operations and contractor staff with environmental management responsibilities. The table is updated each month with information from the Federal Register and other sources, including direct contact with regulatory agencies. Each table entry provides a chronological record of the rulemaking process for that initiative with an abstract and a projection of further action.

46140 (ORNL/TM–10724) **Removal of volatile organic compounds from groundwater: A survey of the technologies.** Singh, S.P.; Counce, R.M. Oak Ridge National Lab., TN (USA). May 1989. 65p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC05-84OR21400. Order Number DE89015653/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Groundwater contaminated with volatile organic compounds (VOCs) is being encountered with greater frequency. Since the natural degradation of these contaminants is very slow, artificial means of removing the organic compounds from the groundwater are required to prevent further deterioration of the aquifer. The technologies which have been employed for the removal of VOCs from groundwater are air stripping, biological treatment, carbon adsorption, chemical oxidation, and membrane separation. This report provides a review of the status of these technologies with particular emphasis on air stripping with emissions control. 72 refs., 6 figs., 7 tabs.

46141 (PB–89-193395/XAB) **Soil chemistry and phosphorus retention capacity of North Carolina coastal plain swamps receiving sewage effluent.** Richardson, C.J.; Walbridge, M.R.; Burns, A. North Carolina Water Resources Research Inst., Raleigh, NC (USA). Nov 1988. 101p. (UNC-WRRI–88-241). Available from NTIS, PC A06/MF A01.

Portions of this document are not fully legible.

Several hundred freshwater swamps in North Carolina currently receive municipal waste-water inputs. In the study researchers examined three Coastal Plain wetlands to (1) characterize their soil chemical properties, (2) determine short-term and long-term effects of effluent additions on soil chemistry, (3) estimate the phosphorus sorption capacities of these swamp soils and determine the relationship between P sorption capacity and soil chemistry, and (4) develop a predictive index to evaluate the P sorption potentials of other N.C. Coastal Plain swamps.

46142 (PB–89-197768/XAB) **Biological treatment of leachate from a Superfund site.** Opatken, E.J.; Howard, H.K.; Bond, J.J. Environmental Protection Agency, Cincinnati, OH (USA). Hazardous Waste Engineering Research Lab. Feb 1989. 10p. (EPA–600/J-89/001). Available from NTIS, PC A02/MF A01.

Pub. in Environmental Progress, Vol. 8, No. 1, 12-18(Feb 1989).

Studies were completed on treating a leachate from New Lyme, Ohio. The leachate was transported to Cincinnati, Ohio, where a pilot-sized rotating biological contactor (RBC) was used for a treatment evaluation. The biomass was developed on the RBC discs with primary effluent from the City of Cincinnati's Mill Creek Sewage Treatment Facility. Experiments were then conducted to determine the effectiveness of treating a hazardous waste leachate and to provide information on the following: the rate of organics removal; the final effluent quality; the fate of priority pollutants and specific organic compounds; and the loss of volatiles via stripping in the RBC. The paper reports on the results from these experiments and the applicability of an RBC to treat a hazardous-waste leachate from a Superfund site.

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Refer also to citation(s) 44737, 44801, 46315, 46341

46143 (AECL–9350) **COSMOS-S/D assessment code complex for a SLB repository at CRNL.** Jarvis, R.G.; Adam, R.Y.; Bretzlaff, C.I.; Laurens, J.M.; Wilkinson, S.R. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Dec 1986. 10p. (CONF-8609350–: 2. international conference on nuclear waste management, Sep 1986). Order Number DE89635083/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The COSMOS-S/D code complex is being developed by the Waste Management Technology Division at CRNL. It models leaching of radionuclides from containment, their migration through vault materials and the ground, their dispersion in surface waters and the atmosphere, and eventual irradiation of man. It is being used at present for safety assessment of a proposed shallow Land Burial Facility, but is is suitable for a wide range of shallow land burial problems. Some examples of its output are given. The scenarios were chosen to be rather conservative, in order to demonstrate the various sections of the code.

46144 (INIS-mf–11504, pp. 243) **Transfer of radionuclides from the environment to vegetation.** Muramatsu, Y. (National Inst. of Radiological Sciences, Ibaraki (Japan)). International Atomic Energy Agency, Vienna (Austria). 1988. (CONF-8804297–: 2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs, 19-22 Apr 1988). In *Co-ordinated research programme on nuclear techniques for toxic elements in foodstuffs. Report on the second research co-ordination meeting, Beijing, People's Republic of China, 19-22 April 1988.* Order Number DE89636003/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Published in summary form only.

46145 (IPEN-PUB–241) **Radionuclide migration studies in soil.** Marumo, J.T. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Jan 1989. 27p. (In Portuguese). Order Number DE89636251/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In this work a brief description about retention and migration parameters of radionuclides in soil, including main methods to determine the distribution coefficient (K) are given. Some of several factors that can act on the migration are also mentioned. (author).

46146 (NSS/G–103) **Chemical and microbiological effects in the near field: current status.** Ewart, F.T.; Pugh, S.Y.R.; Wisbey, S.J.; Woodwark, D.R. United Kingdom Nirex, Ltd., Harwell (UK). Dec 1988. 44p. (HL–89/1077). Order Number DE89636252/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The radionuclide inventory of a radioactive waste repository, influenced by the chemical conditions in the near-field, determines the source term for radionuclides entering the geosphere. The research described in this report is focussed on providing the information necessary to quantify this source term. The processes which interact to determine near field behaviour over a long period of time are complex and a simplified representation is required for radiological assessment modelling. The assumptions made in formulating the near field assessment methodology are discussed and justified in this report. The techniques for acquiring the necessary large body of data for a wide range of relevant radionuclides are also described and the values used in the CASCADE I exercise are given. (author).

46147 (ORNL/RASA–88/17) **Results of the radiological survey at 80 Industrial Road, Lodi, New Jersey (LJ061).** Foley, R.D.; Carrier, R.F.; Floyd, L.M.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jul 1989. 21p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89016235/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 80 Industrial Road, Lodi, New Jersey (LJ061), was conducted during 1985 and 1986. Results of the survey demonstrated radionuclide concentrations in excess of DOE remedial action criteria, primarily from the ^{232}Th decay chain, with some contamination from ^{226}Ra. The radionuclide distributions are typical of the type of material originating from the MCW site. 5 refs., 11 figs., 3 tabs.

46148 (ORNL/RASA–88/57) **Results of the radiological survey at 99 Garibaldi Avenue, Lodi, New Jersey (LJ064).** Foley, R.D.; Floyd, L.M.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jul 1989. 23p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89016038/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 99 Garibaldi Avenue, Lodi, New Jersey (LJ064), was conducted during 1987. Results of the survey demonstrated radionuclide concentrations in excess of the DOE Formerly Utilized Sites Remedial Action Program criteria. The radionuclide distributions are typical of the type of material originating from the MCW site. 4 refs., 8 figs., 3 tabs.

46149 (ORNL/RASA–88/81) **Results of the radiological survey at 126 West Central Avenue, Maywood, New Jersey (MJ038).** Foley, R.D.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 17p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89017336/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 126 West Central Avenue, Maywood, New Jersey (MJ038), was conducted during 1988. Results of the survey indicated scattered radiation or "shine" from a storage pile, located off the property, containing residual radioactive material. Lead-shielded measurements showed radioactivity in the range of normal background for the northern New Jersey area. Radiological assessments of soil samples from the site demonstrate no radionuclide concentrations in excess of DOE Formerly Utilized Sites Remedial Action Program criteria.

46150 (ORNL/RASA–88/82) **Results of the radiological survey at the Electric Substation on West Central Avenue, Maywood, New Jersey (MJ039).** Foley, R.D.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 15p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89017338/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, the Electric Substation on West Central Avenue, Maywood, New Jersey (MJ039), was conducted during 1988. Results of the survey indicated scattered radiation or "shine" from a storage pile, located off the property, containing residual radioactive material. Lead-shielded measurements showed radioactivity in the range of normal background for the northern New Jersey area. Radiological assessments of soil samples from the site demonstrate no radionuclide concentrations in excess of DOE Formerly Utilized Sites Remedial Action Program criteria. 4 refs., 8 figs., 3 tabs.

46151 (ORNL/RASA–88/83) **Results of the radiological survey at 35 West Fairmont Avenue, Maywood, New Jersey (MJ040).** Foley, R.D.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 9p. Sponsored by U.S. DOE Nuclear Energy.

DOE Contract AC05-84OR21400. Order Number DE89017335/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as milch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 35 West Fairmont Avenue, Maywood, New Jersey (MJ040), was conducted during 1988. Results of the survey indicated radioactivity in the range of normal background for the northern New Jersey area. Radiological assessments of soil assessments of soil samples from the site demonstrate no radionuclide concentrations in excess of DOE Formerly Utilized Sites Remedial Action Program criteria. 4 refs., 2 figs., 3 tabs.

46152 (ORNL/RASA–88/99) **Results of the radiological survey at 275 Eccleston Place, Maywood, New Jersey (MJ045).** Foley, R.D.; Crutcher, J.W. Oak Ridge National Lab., TN (USA). Jun 1989. 9p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC05-84OR21400. Order Number DE89017337/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Maywood Chemical Works (MCW) of Maywood, New Jersey, generated process wastes and residues associated with the production and refining of thorium and thorium compounds from monazite ores from 1916 to 1956. MCW supplied rare earth metals and thorium compounds to the Atomic Energy Commission and various other government agencies from the late 1940s to the mid-1950s. Area residents used the sandlike waste from this thorium extraction process mixed with tea and cocoa leaves as mulch in their yards. Some of these contaminated wastes were also eroded from the site into Lodi Brook. At the request of the US Department of Energy (DOE), a group from Oak Ridge National Laboratory conducts investigative radiological surveys of properties in the vicinity of MCW to determine whether a property is contaminated with radioactive residues, principally ^{232}Th, derived from the MCW site. The survey typically includes direct measurement of gamma radiation levels and soil sampling for radionuclide analyses. The survey of this site, 275 Eccleston Place, Maywood, New Jersey (MJ045), was conducted during 1988. Results of the survey indicated radioactivity in the range of normal background for the northern New Jersey area. Radiological assessments of soil samples from the site demonstrate no radionuclide concentrations in excess of DOE Formerly Utilized Sites Remedial Action Program criteria. 4 refs., 2 figs., 3 tabs.

5105 Site Resource and Use Studies

Refer also to citation(s) 44806, 44807, 45195

5106 Regulations

Refer also to citation(s) 44826, 45418, 45426, 46187

46153 (PB–89-204820/XAB) **Superfund Record of Decision (EPA Region 7): Fulbright/Sac River Landfill, Missouri (first remedial action), September 1988. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 30 Sep 1988. 43p. (EPA/ROD/R–07-88/030). Available from NTIS, PC A03/MF A01.

The Fulbright and Sac River Landfills are located just north of the City of Springfield, Missouri, in a semirural area. The landfills were operated by the city for the disposal of municipal and industrial solid wastes. The site, however, could endanger human health or the environment in the future through exposure of the industrial wastes through erosion of the landfill cover. The selected remedial action for this site includes: removal of the drum and drum remnants found in the sinkhole and associated trench east of the Fulbright Landfill; sampling the removed contents to determine hazardous characteristics; proper offsite treatment or disposal.

52 ENVIRONMENTAL SCIENCES, AQUATIC

Refer also to citation(s) 46198

5201 Basic Studies

Refer also to citation(s) 44736, 44876, 44877, 44878, 44879, 44880, 46062, 46067, 46167

46154 (AD-A–208201/4/XAB) **Environmental atlas of the Bering Sea. Final report.** Comiskey, A.L.; Ostrom, J.E. Northern Technical Services, Inc., Anchorage, AK (USA). Oct 1988. 187p. Available from NTIS, PC A09/MF A01.

This atlas contains oceanographic, meteorologic, and air-sea interface information. The information is a composite of traditional climatological and oceanographic data interspersed with non-traditional empirical information useful to Coast Guard operations. Some unique subjects are discussed such as ship operations in first year ice and flying conditions over water. The atlas is also unique in that subjects are discussed both briefly (first portion of atlas) and extensively (second portion) to accommodate readers with different levels of interest. Contents–Physical Geography; Factors Affecting Oil Spill Transport; Factors Affecting Oil Spill Containment or Mitigation Efforts; Oceanography; Climatology and Meteorology; Sea Ice; Ship and Equipment Operations in First Year Ice; Appendices: Sunrise/Sunset Tables, Storm Surge Forecast Procedures; Glossary of Ice Terms.

46155 (MNR/FB–88-12) **Summary of fish population data from Sipiwesk and Cross Lakes, 1987.** Manitoba Dept. of Natural Resources, Winnipeg, MB (Canada). Fisheries Branch. 1987. 101p. (MICROLOG–89-02359). Available from Manitoba Natural Resources, Public Information Services, 1495 St. James St., PO Box 22, Winnipeg, MB, CAN R3H 0W9; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Cross and Sipiwesk lakes are located on the Upper Nelson River System. Cross Lake is immediately downstream of Manitoba Hydro's Jenpeg Generating Station while Sipiwesk Lake is just downstream of Cross Lake. Lake Winnipeg Regulation and the operation of Jenpeg Generating Station both have an influence on water level and flow conditions through these two lakes. In 1985 an ecological monitoring program was initiated to investigate and document the possible impact of hydro development on fish populations within the Churchill River Diversion and Nelson River Systems. Cross and Sipiwesk lakes were two of the six lakes chosen for annual sampling. The purpose of this report is to present the fish population data collected from Cross and Sipiwesk lakes in 1987 in a form that will make it readily and more easily available for future reference. 4 refs., 35 figs., 47 tabs.

46156 (MNR/FB–88-15) **Fish population data from Split and Stephens lakes, 1987.** Hagenson, I. Manitoba Dept. of Natural Resources, Winnipeg, MB (Canada). Fisheries Branch. 1988. 79p. (MICROLOG–89-03340). Available from Manitoba Natural Resources, Public Information Services, 1495 St. James St., PO Box 22, Winnipeg, MB, CAN R3H 0W9; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The data presented in this report were collected as part of an ecological monitoring project to ascertain and evaluate current impacts and long-term effects of existing and planned hydroelectric developments in northern Manitoba on abiotic and biotic environments in affected lakes and watercourses. The function of this report is to provide baseline data on the fish populations of Split and Stephens lakes which were sampled in the summer of 1987. The collected data are summarized with special emphasis on the relative abundance of each species and the effects of various mesh sizes on fish species. Growth rates, age composition, maturity, survival

and mortality rates of whitefish (Coregonus clupeaformis), walleye (stizostedion vitreum vitreum), sauger (Stizostedion canadense) and northern pike (Esox lucius) are also described, in order to provide a data base for future management. 3 refs., 26 figs., 33 tabs.

46157 (NEI-NO–82, pp. 69-78) **Interaction in the water-sediment system: Pathways of the water composition.** Kunznetsov, V.A.; Zhukhovitskaya, A.L.; Generalova, V.A. Norsk Hydrologisk Komite, Oslo (Norway). 1987. (CONF-870577–: International symposium on acidification and water pathways, 4-8 May 1987). In *Acidification and water pathways. Vol. 1. Proceedings of International symposium on acidification and water pathways, Bolkesjoe, 4-5 May 1987.* Order Number DE89766881/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Surface waters in a generic series: river-peat bog-lacustrine waters are studied. The rain natural processes of these environments which determine the migration of typomorphic elements and the pathways of hydrochemical composition formation are distinguished. 4 tables, 11 references.

46158 (NEI-NO–82, pp. 79-90) **Effect of vegetation cover (pine forest vs. no vegetation) on atmospheric desposition and soil acidification.** Mulder, J.; Dobben, H.F. van; Visser, P.H.B. de; Booltink, H.W.G.; Breemen, N. van. Norsk Hydrologisk Komite, Oslo (Norway). 1987. (CONF-870577–: International symposium on acidification and water pathways, 4-8 May 1987). In *Acidification and water pathways. Vol. 1. Proceedings of International symposium on acidification and water pathways, Bolkesjoe, 4-5 May 1987.* Order Number DE89766881/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

The impact of a forest cover on total atmospheric acid load, internal soil acidification and the Al chemistry was studied at two adjacent driftsands, one with Scots Pine and one without vegetation. Soils are acidic, with low base cation contents, CEC and base saturation. Annual chemical budgets were estimated for a 1-year period from solute concentrations, amounts of precipitation and throughfall, calculated soil water fluxes, and measurements on litterfall and tree grovth. Annual (NH-4)-2SO-4 deposition was higher in the forest (2.0 kmol ha^{-1}) than on the bare sand (0.9 kmol ha -1). The total acid load was primarily due to NH-4 transformation, and was very high in the forest soil and considerably lower in the bare sand (6.2 and 3.0 kmol ha-1, respectively). Acid inputs were mainly neutralized by Al solubilization, giving high dissolevd Al concentrations (in the forest soil mean 1400 mmol (+)m^{-3}). Sulphate sorption was not observed. Soil solutions at the bare site were saturated with gibbsite at depths greater than a few cm below the soil surface. The forest soil solutions were undersaturated with gibbsite in the rootzone (0 to 40 cm) and only reached equilibrium with gibbsite at greater depth. Regulation of the Al activity by jurbanite must be excluded in our soils. 1 figure, 5 tabels, 18 references.

46159 (NEI-NO–82, pp. 291-301) **Adirondack lake system acidity: Differences between headwater and nonheadwater lakes.** Hunsaker, C.T.; Olson, R.J.; Carpenter, D.E. Norsk Hydrologisk Komite, Oslo (Norway). 1987. (CONF-870577–: International symposium on acidification and water pathways, 4-8 May 1987). In *Acidification and water pathways . Vol. 1. Proceedings of International symposium on acidification and water pathways, Bolkesjoe, 4-5 May 1987.* Order Number DE89766881/JAW. Available from NTIS (US Sales Only), PC A20/MF A01.

Surface water acidification may be caused or influenced by natural watershed processes and by anthropogenic activities. One portion of the U.S. National Acid Precipitation Assessment Program focused on lake acidity as related to natural and anthropogenic watershed attributes in the Adirondack region of New York. The objectives were to build a series of data sets for complex watershed systems that would complement those developed for headwater lake and analyze empirical relationships lake pH and watershed attributes for complex watershed system, to determine if different processes operate in headwater and noheadwater watersheds. Sixty-six watersheds systems (258 lakes) were studied, using chemistry data available for one-half of these lakes. Results show that headwater lakes had a slightly lower average pH (0.26 units) than nonheadwater lakes. Physical and chemical soil attributes were related to differences in lake acidity between headwater and nonheadwater lakes. 3 figures, 2 tables, 6 references.

46160 (OME–APIOS-1988) **Acid sensitivity of lakes in Ontario.** Ontario Ministry of the Environment, Toronto, ON (Canada). Acid Precipitation in Ontario Study. 1988. 27p. (In English and French). (MICROLOG–89-02261). Available from Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Ontario Ministry of the Environment conducts surveys to determine the sensitivity of Ontario lakes to acidic precipitation. This report presents a summary of the latest results of this survey and includes information on 6,467 lakes throughout the province. Lakes are arranged alphabetically by county or district, and a sensitivity index on a scale of 1 to 5 is given for each lake sampled. A summary table shows that 25.0% of the lakes were found to be not sensitive to acidification, and a further 17.2% had low vensitivity. Lakes classified as acidic represented 5.2% of the total and 15.7% were classified as extremely sensitive. 1 tab.

46161 (OME/WRB–DR84-2) **Macrophyte data from 46 southern Ontario soft-water lakes of varying pH.** Hitchin, G.G.; Wile, I.; Miller, G.E.; Yan, N.D. Ontario Ministry of the Environment, Toronto, ON (Canada). Water Resources Branch. [1989]. 153p. (MICROLOG–89-02129). Available from Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

To determine the influence of lake acidification and trace metal contamination on aquatic plant communities, a survey was conducted of 46 lakes of varying pH and metal levels in southern Ontario. The occurrence, distribution and abundance of vascular and non-vascular aquatic macrophytes in these lakes is detailed in this report. Maps are also presented showing locations of all sampling transects. A total of 79 plant species were surveyed, 50 of which were vascular macrophytes, 23 aquatic mosses and 6 stoneworts. There was a positive relationship between maximum plant depth and water clarity. The range of depths of plant occurrence varied among species, generally resulting in a vertical zonation of species. Total plant cover in the 46 lakes appeared to be related to lake pH; plant cover exceeded 50% on proportionately more transects in the acidic lakes. 10 refs., 52 figs., 51 tabs.

46162 (PB–89-192983/XAB) **Population status of California sea otters.** Minnesota Univ., Minneapolis, MN (USA). Dept. of Ecology and Behavioral Biology. 30 Nov 1988. 394p. Available from NTIS, PC A17/MF A01.

See also PB–85-174035.

The main objective of the study was to develop a simulation model to facilitate analysis of the risk of oil spills to the threatened California sea otter population. Existing data on the dynamics and demography of the population were synthesized. The additional data needed for model development were collected through radiotelemetry studies of sea otters in Alaska and California. The simulation model contains four interrelated stochastic submodels: a short-term population model, a long-term population model, a sea otter distribution model, and a sea otter movement model. The report includes a detailed description of the model, the data on which it is based, and an operating manual.

5202 Chemicals Monitoring and Transport

Refer also to citation(s) 44521, 44782, 44783, 44796, 45189, 45427, 46082, 46123, 46128, 46130, 46131, 46132, 46133, 46137, 46140, 46141, 46142, 46183, 46328, 46329, 46330, 46331

46163 (AD-A–208109/9/XAB) **Influence of well casing composition on trace metals in ground water. Special report.** Hewitt, A.D. Cold Regions Research and Engineering Lab., Hanover, NH (USA). Apr 1989. 22p. (CRREL-SP–89-9). Available from NTIS, PC A03/MF A01.

These experiments determined the concentration dependence of trace inorganic priority pollutants (As, Cd and Pb) in ground water solutions exposed to polyvinylchloride (PVC), polytetrafluoroethylene (PTFE) and two types of stainless steel (SS304 and SS316). The

test design used a factorial screening matrix with two concentrations of metals (As-Cr-Pb, 50 and 10 micrograms/L; C/d, 10 and 2 micrograms/L), pH (5.8 and 7.7), and total organic carbon (natural and natural plus 5 mg/L humic acid) as variables. Samples containing well casings and controls without pipe sections were run as duplicates. Aliquots were removed from all of the solutions after 0.5,4,8,24 and 72 hours. Aqueous metal concentrations were determined by graphite furnace atomic absorption spectroscopy. The results showed PTFE to have no significant influence on the metals monitored under any of the groundwater conditions. Metal concentrations in ground water exposed to SS316 and SS304 had large random variances believed to be caused by surface oxidation of the stainless steel. PVC had a more active surface than PTFE in terms of both sorption of Pb and of Cd.

46164 (AD-A–208124/8/XAB) **Storage capacity evaluation for Craney Island expansion alternatives. Final report.** Poindexter-Rollings, M.E. Army Engineer Waterways Experiment Station, Vicksburg, MS (USA). Environmental Lab. Apr 1989. 102p. (WES/TR/EL–89-6). Available from NTIS, PC A06/MF A01.

Since the 1950s the Craney Island disposal facility has been used for containment of dredged material from the navigable channels and harbors of Hampton Roads, VA. The site has annually received between 3 and 4-million cu m of maintenance dredged material. Since the existing site is nearing maximum capacity, studies were begun to evaluate potential expansion alternatives in an effort to identify the alternative that will maximize existing storage capacity (and provide approximately 50 years of additional storage capacity) while minimizing environmental impacts. The focus of this study was the volumetric storage capacity of each alternative, while two other concurrent studies evaluated separately; (a) the hydrodynamic impacts of each expansion alternative on the flow regime in the Hampton Roads area; and (b) the geotechnical feasibility of constructing retaining dikes for each alternative. The storage capacity, and thus the remaining active disposal life, of the existing Craney Island facility was determined as well as that of each expansion alternative, both with and without considering the existing facility. The scenarios were evaluated assuming an active dewatering program. The influence of subdividing the expansion facility into multiple compartments was also evaluated. Input requirements to the computer program (Primary Consolidation and Desiccation of Dredged Fill), necessitated compilation of the consolidation characteristics of the foundation soil and dredged material as well as the appropriate values to simulate site dewatering.

46165 (ANL/EES-TM–377) **Determination of ecologically vital groundwaters at selected sites in the Formerly Utilized Sites Remedial Action Program.** Vinikour, W.S.; Yin, S.C.L. Argonne National Lab., IL (USA). Aug 1989. 48p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract W-31109-ENG-38. Order Number DE89015642/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The US Department of Energy is classifying groundwaters at sites in its Formerly Utilized Sites Remedial Action Program (FUSRAP). Of particular concern is the potential presence of groundwaters that are highly vulnerable to contamination and that are either (1) irreplaceable sources of drinking water or (2) ecologically vital. Conditions at nine FUSRAP sites were evaluated to determine if ecologically vital groundwaters are present. The sites evaluated were Wayne Interim Storage Site, Maywood Interim Storage Site, and Middlesex Sampling Plant in New Jersey; Ashland 2 Site, Seaway Industrial Park, Colonie Interim storage Site, and Niagara Falls Storage Site in New York; and the St. Louis Airport Site and Hazelwood Interim Storage Site in Missouri. The analyses indicated that groundwaters are vulnerable to contamination at all but two of the sites – the Ashland 2 and Seaway Industrial Park sites in New York. Groundwater discharge points were identified within a 2-mile radius (i.e., the classification review area) of all of the sites. No ecologically vital groundwater areas exist in the vicinities of any of the nine FUSRAP sites evaluated. 35 refs., 17 figs.

46166 (CONF-881054–Vol.1, pp. 93-104) **Development of a driven multilevel groundwater sampling well and instrumentation for measuring vertical hydraulic gradient over short distances.** Young, S.C. (Tennessee Valley Authority Engineering Lab., Norris (USA)); Boggs, J.M. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

A natural gradient tracer experiment is currently underway at Columbus Air Force Base in Mississippi to investigate field-scale dispersion of groundwater solutes. The heterogeneity of the alluvial aquifer at the test site produces a complex hydraulic gradient field with vertical gradients that are two orders of magnitude larger than horizontal gradients at some locations. A driveable multilevel sampling well was developed for tracer sampling which minimizes the potential for artificial vertical groundwater movement in the disturbed annulus around the well in the presence of vertical hydraulic gradients. Methods were also developed for measuring the hydraulic heads in the sampling tubes of the multilevel samplers to examine the detailed hydraulic head field in the vicinity of the sampler. These methods include a vacuum manifold manometer, a tetrabromoethane manometer, and a differential pressure cell.

46167 (CONF-890975–2) **Volatilization, methylation, and demethylation of mercury in a mercury-contaminated stream.** Turner, R.R.; VandenBrook, A.J.; Barkay, T.; Elwood, J.W. Oak Ridge National Lab., TN (USA). 1989. 4p. Sponsored by Environmental Protecction Agency. DOE Contract AC05-84OR21400. From 7. international conference on heavy metals in the environment; 12-15 Sep 1989. Order Number DE89014099/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Environmental Science Divison publication No. 3326.

Radiolabeled mercury compounds introduced into water and sediment samples from a mercury-contaminated stream in Oak Ridge, Tennessee, USA, exhibited both abiotic and biotic transformations. Abiotic reduction of mercuric ion accounted for 10 to 70% of the volatilization of elemental mercury from water samples. Biotic reduction and volatilization increased in warmer months and proceeded rapidly without a lag period. Biotic methylation of mercuric ion was unexpectedly low (<0.2% of added mercuric was methylated in 2 days) and was consistently detectable only in water samples with added sediment (1% solids). Although the presence of sediment appeared to promote methylation of added mercuric ion, one experiment with radiolabeled sediment showed that sediment-bound mercury was essentially unavailable for methylation. Biotic demethylation of introduced methylmercury chloride in water samples was very efficient (>90% of the radiolabeled spike was demethylated and evolved as elemental mercury in <5 days). Although demethylation capacity was high in samples from the study stream, net production of methylmercury was unexpectedly low primarily because the substrate for methylation, mercuric ion, is rapidly lost from the solution phase by reduction and volatilization, and by adsorption to suspended sediment. 4 figs.

46168 (EC/Q/CP–8703) **Effects of acid precipitation on a boreal forest ecosystem. Ion budgets and changes in water chemistry for the Laflamme Lake watershed.** Papineau, M. Environment Canada, PQ (Canada). Conservation and Protection. 1987. 122p. (MICROLOG–87-06101). Available from Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Data on surface waters have been gathered at the Laflamme Lake Watershed in Quebec as part of an ion budget research program. This watershed was set up in 1980 to assess the effects of long range transport of airborne pollutants on a boreal forest ecosystem receiving moderate to high sulphate loading. Precipitation data indicates that between 1981 and 1984, the average pH of water falling onto the watershed was 4.4, that precipitation quality is cyclic and that loading is episodic. The main components of precipitation on an equivalent basis are sulfate, hydrogen, nitrate and ammonium ions. ALthough the sulphate to nitrate ration is 2:1 on a yearly basis, nitrate ions are more important than sulphates in January. Since water and pollutants build up in the snowpack, spring melt is a critical period during which concentrations in surface waters and exports from the watershed are modifed for many parameters especially hydrogen and bicarbonate ions. Lake water quality is characteristic of lakes that are very sensitive to acidification. High sulfate values seem to indicate that the watershed has

been affected by atmospheric loading. The average pH of the lake (6.4) indicates that the lake is not yet greatly acidified. Important buffering occurs in the soil and surficial deposits of the watershed. Stream water is slightly less mineralized, slightly more acidic and shows more pronounced changes in water quality than lake water. Over the last five years, sulfate, conductivity and some heavy metal levels have increased in surface waters while no significant trends were seen for pH and alkalinity. In other Quebec monitoring lakes, trends of decreasing pH were seen during this period. When wet loading is compared to stream output, hydrogen and nitrate ions are seen to be retained in the watershed while Ca, Mg, Na, K, sulphate and chloride are lost. 63 refs. 31 figs. 32 tabs.

46169 (ETDE-mf–9914835) **Exploration ship METEOR - cruise no. 6. ATLANTIK 87/88 - legs no. 1-3 October-December 1987.** Berichte aus dem Institut fuer Meereskunde an der Christian-Albrechts-Universitaet Kiel. Mueller, T.J.; Siedler, G.; Zenk, W. Institut fuer Meereskunde an der Univ. Kiel (Germany, F.R.). 1988. 86p. (In German). Order Number DE89914835/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

The first three legs of METEOR cruise no. 6 were carried out between Hamburg, Las Palmas, Dakar and Abidjan. The core programme was part of the special research programme 'Warm Water Sphere of the Atlantic' at Kiel University. It included investigations of the North Atlantic subtropical gyre circulation and of mixing processes in the Cape Verde Frontal Zone. Tracer sampling was added to this programme. Furthermore, measurements were carried out to study heavy metals and petroleum hydrocarbons, and samples were collected for investigations of the oceanic particle flux, of the taxonomy and regional distribution of ichthyoplankton and of benthic communities. Air chemistry measurements were aimed at determining mixing ratios of various trace gases in the tropospheric boundary layer. The present report summarizes the goals of the investigations, the work at sea and first results. (orig.).

46170 (FO–1987) **Acidification of surface waters in eastern Canada and its relationship to aquatic biota.** Kelso, J.R.M.; Minns, C.K.; Gray, J.E.; Jones, M.L. Department of Fisheries and Oceans, Ottawa, ON (Canada). 1987. 47p. (In French). (MICROLOG–87-04650). Available from Canada Dept. of Fisheries and Oceans, Scientific Publications, 200 Kent St., 14th Floor, Ottawa, ON, CAN K1A 0E6; $6.00; OTHER COUNTRIES: $7.20 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Data collected in lakes and rivers of eastern Canada subjected to atmospheric deposition, essentially >20 kg SO_4^2 hectarely, indicated that the trend of fewer species of fish, phytoplankton, zooplankton, and benthos below pH 6 persists. Not only are there fewer species below pH 6, but also the abundance of at least fish (as reflected by catch per unit effort) declines with decreasing pH. It is also evident that physical limits of the aquatic habitat exerts a strong influence upon diversity at all community levels. This intrinsic effect from the habitat is then further influenced by pH and alkalinity. Fish body burdens of trace metals (Hg, Al, Mn, Fe) appear weakly related to lake pH/alkalinity conditions. All provinces had fish from remote lakes with body burdens of Hg in excess of human health guidelines. In all provinces except New Brunswick, 27–47% of lakes had fish exceeding these public health guidelines. All indicators of lake sensitivity suggest that freshwaters, and consequently, the fishery resource, of Nova Scotia are by far the most senstive (>1 200 km^2 of lake surface area already acidic; alkalinity pH 5.3 and less). Overall, it is estimated that there are 700,000 lakes in eastern Canada receiving deposition considerably above background; that 4,243 km^2 (> 14,000 lakes) are currently acidic; and that more than 150,000 lakes have a pH<6.0, a level identified as a threshold of effect. 80 refs 11 figs 35 tabs

46171 (HW–11642) **Fish and fish problems of the Hanford Reservation.** Olson, P.A. Hanford Works, Richland, WA (USA). 23 Nov 1948. 7p. Sponsored by U.S. DOE Environment Health & Safety. DOE Contract AC06-76RL01830. Order Number DE89016478/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

The Columbia River, which is the largest river on this coast having a length of approximately 1200 miles and draining some 259,000 square miles, has long been one of the most productive fish streams in the world. In addition to the salmon industry which has an annual wholesale value of somewhere around ten million dollars, considerable sport-fishing for salmon, trout, sturgeon, bass and whitefish exists. The utilization of Columbia River for power, navigation, industry, irrigation and municipal needs is becoming ever greater. In competition with man and man's influences the commercially valuable fish runs are steadily declining in number. In utilizing vast quantities of water the Hanford Works joins this man made list of competitors with the fish populations. A brief history of the development of the Columbia River basin is of interest.

46172 (ORNL/TM–11252) **Final report of the Oak Ridge Task Force concerning public health impacts of the off-site contamination in East Fork Poplar Creek and other area streams.** Travis, C.C.; Blaylock, B.G.; Daniels, K.L.; Gist, C.S.; Hoffman, F.O.; McElhaney, R.J.; Weber, C.W. Oak Ridge National Lab., TN (USA). Aug 1989. 32p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016938/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

As a result of operations associated with the Department of Energy (DOE) facilities near Oak Ridge, Tennessee, a nearby creek, East Fork Poplar Creek (EFPC), became contaminated with mercury and trace levels of other metals, organics and radionuclides. An interagency task force, identified as the Oak Ridge Task Force (ORTF) was organized to investigate the extent of off-site environmental contamination of EFPC and other area streams related to the Oak Ridge Reservation, and to determine if any immediate public health impacts might result from such contamination. Four study groups were established by the ORTF to supervise investigations of fisheries, groundwater, soils, surface water, sediment, and floodplains. A fifth study group was established to perform an evaluation of possible public health impacts. The DOE also authorized several organizations to collect and analyze samples and make field measurements needed by the Task Force. The Tennessee Valley Authority (TVA) was authorized to perform an instream contaminant study to determine the extent of contamination of surface water, sediment, fish, and floodplains. The US Geological Survey (USGS) was authorized to determine the extent of groundwater contaminant. Oak Ridge Associated Universities (ORAU) was charged with determining the extent of contamination of the terrestrial foodchain which might be consumed by humans. Oak Ridge National Laboratory (ORNL) was requested to provide assistance in health impact assessments. 19 refs., 12 tabs.

46173 (PB–89-190573/XAB) **USEPA (United States Environmental Protection Agency) method study 35. SW method 3005. Acid digestion of waters for total recoverable or dissolved metals for analyses by flame atomic absorption spectroscopy. Report for September 1986-December 1987 (Final).** Edgell, K.W. Bionetics Corp., Cincinnati, OH (USA). Apr 1989. 281p. Available from NTIS, PC A13/MF A01.

An interlaboratory collaborative study was conducted to determine the precision and bias (recovery) of Solid Waste (SW) Method 3005 for the analysis of 21 elements in ground water. The study design was based upon Youden's non-replicate plan for collaborative tests of analytical methods. Each water type was spiked with six concentrations (as three Youden pairs) of the 21 test elements and was prepared using nitric/hydrochloric acid digestion and analyzed by Atomic Absorption (AA-Direct Aspiration). Test data from three spiked ground water sources were compared against reagent water which was used as a control. The study produced, for each element, measures of precision and mean recovery for the acid digestion/AA-Direct Aspiration and compared the performance of the method between water types and reagent water.

46174 (PB–89-192587/XAB) **Pesticides in ground-water data base: 1988 interim report.** Environmental Protection Agency, Washington, DC (USA). Office of Pesticide Programs. Dec 1988. 39p. Available from NTIS, PC A03/MF A01.

One of EPA's priorities is to determine the extent of pesticides occurring in the nation's ground water. While many individual, localized ground-water monitoring studies have been conducted across the country, there has been no comprehensive compilation of these results. In response to this, the EPA's Office of Pesticide Programs has developed the Pesticides in Ground Water Data Base. The data base contains information derived from monitoring studies conducted by pesticide registrants, universities, and government

agencies. The data base identifies the pesticides that have been looked for in ground water, the areas that have been monitored, and the pesticides that have been detected. The data base was developed in the first quarter of 1988, and at the same time, a public docket was established so interested parties could have access to the source information. Following the development of the data base, the EPA has been conducting a program to assess the validity of the information it contains. At this time, the authors believe they have gathered sufficient information to provide the public with an interim report on the national status of pesticide residues in ground water.

46175 (PB–89-197115/XAB) **Regional ground-water quality characterization of the Rockford area, Winnebago County, Illinois: An assessment of volatile organic compounds and selected trace metals.** Wehrmann, H.A.; Holm, T.R.; Stecyk, A.N.; Le Seur, L.P.; Curtiss, C.D. Illinois State Water Survey Div., Champaign, IL (USA). Ground-Water Section. Sep 1988. 124p. Available from NTIS, PC A06/MF A01.

This report summarizes an investigation of regional ground-water quality in the Rockford area in north-central Illinois. The investigation was launched to determine if regional ground-water contamination, principally by volatile organic compounds (VOCS), has occurred in the Rockford area. A number of investigations conducted by local and state agencies have documented the presence of VOCs in the ground water at several locations in or near the city of Rockford, Illinois. An estimated 300 wells, including 16 public water supply wells, were affected by the presence of organic compounds in over 20 instances of ground-water contamination in Winnebago County documented since 1970. Despite the fact that several wells were found to contain VOCs, the preponderance of information collected during the study shows that regional contamination of ground water in the Rockford area has not occurred.

46176 (PB–89-197495/XAB) **Anaerobic biodegradation of 2,4-dichlorophenol in freshwater lake sediments at different temperatures.** Kohring, G.W.; Rogers, J.E.; Wiegel, J. Georgia Univ., Athens, GA (USA). 1989. 8p. Available from NTIS, PC A02/MF A01.

Pub. in Applied and Environmental Microbiology 55, No. 2, 348-353(Feb 1989).

Anaerobic degradation of 2,4-dichlorophenol (2,4-DCP) between 5 and 72C was investigated. Anaerobic sediment slurries prepared from local freshwater sediments were partitioned into anaerobic tubes or serum vials, which then were incubated separately at the various temperatures. Reductive 2,4-DCP dechlorination occurred only in the temperature range between 5 and 50C, although methane was formed up to 60C. In sediment samples from two sites and at all temperatures from 5 to 50C, 2,4-DCP was transformed to 4-chlorophenol (4-CP). The 4-CP intermediate was subsequently degraded after an extended lag period in the temperature range from 15 to 40C. Adaptation periods for 2,4-DCP transformation decreased between 5 and 25C, were essentially constant between 25 and 35C, and increased in the tubes incubated at temperatures between 35 and 40C. This suggests that at least two different organisms were involved in the transformation of 2,4-DCP to 4-CP.

46177 (PB–89-200398/XAB) **Sediment-quality-values refinement. Volume 1. 1988 update and evaluation of Puget Sound AET (Apparent Effects Threshold). Final report.** Barrick, R.; Becker, S.; Brown, L.; Beller, H.; Pastorok, R. PTI Environmental Services, Bellevue, WA (USA). Sep 1988. 177p. Available from NTIS, PC A09/MF A01.

See also PB–89-200406.

This report contains a detailed evaluation of the Apparent Effects Threshold (AET) approach. The AET approach can be used to develop chemical-specific sediment-quality values. As part of the effort, AET values were generated for Puget Sound, Washington, and applied in a predictive manner to approximately 300 stations. The objective of the investigation was to test the reliability of AET, and potential sediment quality standards based on AET, in predicting adverse biological effects associated with sediment contamination. Of the 201 benthic infauna stations and 287 amphipod bioassay stations evaluated, approximately 75% were in accordance with AET predictions. Approximately 96% of the 50 stations at which oyster larvae and microtox bioassays performed were in accordance with AET predictios. Based on AET for the four biological indicators, Puget Sound maps were produced showing the location of predicted impacts in the estuary. The effort involved the generation and evaluation of AET for 58 metal and organic chemicals.

46178 (PB–89-200406/XAB) **Sediment-quality-values refinement. Volume 1. Data appendices. 1988 update and evaluation of Puget Sound AET (Apparent Effects Threshold). Final report.** Barrick, R.; Becker, S.; Brown, L.; Beller, H.; Pastorok, R. PTI Environmental Services, Bellevue, WA (USA). Sep 1988. 296p. Available from NTIS, PC A13/MF A01.

See also PB–89-200398.

The report contains a detailed evaluation of the Apparent Effects Threshold (AET) approach. The AET approach can be used to develop chemical-specific sediment-quality values. As part of the effort, AET values were generated for Puget Sound, Washington, and applied in a predictive manner to approximately 300 stations. The objective of the investigation was to test the reliability of AET, and potential sediment-quality standards based on AET, in predicting adverse biological effects associated with sediment contamination. Of the 201 benthic infauna stations and 287 amphipod bioassay stations evaluated, approximately 75% were in accordance with AET predictions.

46179 (PB–89-866362/XAB) **Bioindicators of marine pollution. January 1974-July 1989 (Citations from Oceanic abstracts). Report for January 1974-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 144p. Available from NTISPC N01/MF N01.

Supersedes PB–86-873916.

This bibliography contains citations concerning the utilization of marine plants and animals as indicators of organic and inorganic pollutant distribution. Topics include descriptions of specific species and assemblages, regional and local monitoring studies, and analyses of the soft and hard parts of marine animals. Studies of algae, bivalves, corals, crustaceans, bacterial counts, and seagrasses in estuaries and benthic areas are included. (This updated bibliography contains 296 citations, 40 of which are new entries to the previous edition.)

46180 **Process for removing metals from water.** Napier, J.M.; Hancher, C.M.; Hackett, G.D. To Dept. of Energy, Washington, DC. USA Patent 4,814,091. 21 Mar 1989. Filed date 29 Jun 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A process for removing metals from water including the steps of prefiltering solids from the water, adjusting the pH to between about 2 and 3, reducing the amount of dissolved oxygen in the water, increasing the pH to between about 6 and 8, adding water-soluble sulfide to precipitate insoluble sulfide and hydroxide-forming metals, adding a flocculating agent, separating precipitate-containing floc, and postfiltering the resultant solution. The postfiltered solution may optionally be eluted through an ion exchange resin to remove residual metal ions.

5203 Radioactive Materials Monitoring and Transport

Refer also to citation(s) 44676, 45841, 45842, 45843, 45889, 46082, 46143, 46171, 46172, 46759

46181 (AECL–9345) **Hydrogeologic studies for CRNL's proposed shallow land burial site.** Killey, R.W.D.; Devgun, J.S. Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Sep 1986. 14p. (CONF-8609350–: 2. international conference on nuclear waste management, Sep 1986). Order Number DE89635117/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The first phase of conversion from storage to disposal of low- and intermediate-level radioactive wastes at CRNL is focussed on solids with hazardous lifetimes less than 500 years. In order to use a facility buried above the water table and to achieve maximum use of radionuclide migration information from studies of existing facilities, the proposed site is located in sands above an active groundwater flow system. The selection of a permeable and geologically-simple slow system has allowed application of a wide variety of techniques for hydrogeologic evaluation of the site. Ground-probing radar in

conjunction with continuously cored boreholes have provided stratigraphic data and sediments for testing. Field hydrogeologic testing has included a detailed network of piezometers for hydraulic head mapping and a series of borehole dilution tests. Measurements of contaminant sorption behaviour are also being made in the field to reduce variations in uncontrolled parameters. Mathematical models successfully simulate the real system in terms of groundwater flow. Simulations of reactive contaminant transport are more difficult, but the application of data from field tests of radionuclide migration behaviour and from existing contaminant plumes will, we believe, provide acceptably reliable predictions of the impact of failures in the engineered disposal structure.

46182 (CONF-890975–1) **Radionuclide tracers for the fate of metals in the Savannah estuary: River-ocean exchange processes.** Olsen, C.R.; Thein, M.; Larsen, I.L.; Byrd, J.T.; Windom, H.L. Oak Ridge National Lab., TN (USA). 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 7. international conference on heavy metals in the environment; 12-15 Sep 1989. Order Number DE89013056/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Plutonium-238 from the US Department of Energy's Savannah River Plant labels riverborne particles, providing a unique opportunity for examining the fate of metals in estuaries and for tracing river-ocean exchange processes. Results indicate that plutonium and lead-210 are enriched on estuarine particles and that inputs of plutonium from oceanic sources greatly exceed inputs from riverborne or drainage-basin sources as far upstream as the landward limit of seawater penetration. We suggest that these radionuclides (and other chemically reactive metals) are being scavenged from oceanic water by sorption onto particles in turbid estuarine and coastal areas. Since estuaries, bays, mangroves, and intertidal areas serve as effective traps for fine particles and associated trace substances, these results have important implications concerning the disposal of chemically reactive substances in oceanic waters. 13 refs., 1 fig., 1 tab.

46183 (HW–56242) **Interim report on the origin of reactor effluent water radioisotopes: Analysis of Turco purge material.** Perkins, R.W. General Electric Co., Richland, WA (USA). Hanford Atomic Products Operation. 3 Jun 1958. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89016479/JAW. Available from NTIS, PC A03/MF A01 - OSTI.

Declassified 17 Aug 1989.

A research program is underway in the Analytical Chemistry group for the purpose of determining the origin of the more important reactor effluent water radioisotopes. As part of this program the radioisotopic composition of the film material which is formed on the surface of process tubes and fuel elements was to be determined. A recent production test (IP-161-AE, HW-55849) performed by IPD Radiological Engineers, using the chemical cleaner Turco 4306B, has provided samples of this film material for radioisotopic analysis. Because of the relatively large amounts of radioisotopes removed by a Turco purge, compared with diatomaceous earth purges and the possibility of a future full-pile decontamination with Turco and its subsequent disposal to the river, the results of this study are being published so that proper hazard evaluations can be made.

46184 (JINR-N–5(31)-88, pp. 13-20) **Search for the spontaneously fissioning nuclide in Cheleken hot brines.** Dmitriev, S.N.; Flerov, G.N.; Azarov, V.A.; Shishkin, S.V.; Lebedev, V.Ya.; Krasnov, A.V.; Shishkina, T.V.; Pokrovskij, V.K.; Sokol, E.A. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012200/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

By using the method of chemical enrichment (coprecipitation, cementation, sorption, extraction etc.) the isolation of trace elements from the hot brines of the Cheleken peninsula was carried out. Some 10-15 m^3 of brine were processed in a single experiment. The concentration factor for the trace elements reached the value 10^3-10^5. The samples obtained were studied using a ^{3}He-counter neutron- multiplicity detector. No spontaneously fissioning nuclide (SFN) was revealed in the samples at a detection limit of 10^{-13} g/g. The possible explanations of that are discussed. On the basis of the special study of the chemical forms of the trace elements, the possible analogs of superheavy elements in hot brines, and from the analysis of the results of the present and previous searches for the SFN in Cheleken hot brines an assumption has been advanced that the SFN is present in the brines as compounds with organic admixtures, like gold and mercury are. Prospects of further work aimed at detecting the SFN in Cheleken hot brines are discussed. 19 refs.; 2 tabs.

46185 (PB–89-126148/XAB) **Environmental radionuclide concentrations in the vicinity of the calvert cliffs nuclear power plant: 1985-1986. Final report.** Domotor, S.L.; McLean, R.I. Maryland Power Plant Research Program, Annapolis, MD (USA). Nov 1988. 53p. (PPRP/PPER-R–10). Available from NTIS, PC A04/MF A01.

See also PB–88-150297.

High-resolution gamma spectroscopy was used to determine radionuclide concentrations in sediment, finfish, shellfish, and aquatic vegetation collected from the Chesapeake Bay in the vicinity of the Calvert Cliffs Nuclear Power Plant (CCNPP) during 1985-1986. Low concentrations of radionuclides attributable to CCNPP (Ag-110m, Co-58, Co-60, and Zn-65) were detected in all biota (except edible finfish) and in sediments. Silver-110m was the principal CCNPP-related radionuclide detected in biota (particularly oysters); Co-58 and Co-60 were the principal CCNPP-related radionuclides detected in sediments. CCNPP-related radionuclide concentrations detected in Bay biota and sediments were within ranges observed in previous years and represent small increments to radionuclide concentrations in the Bay relative to natural and weapons test levels.

5205 Site Resource and Use Studies

Refer also to citation(s) 45382, 46122

46186 (PB–89-193361/XAB) **Stable-isotope investigation of vapor transport during ground-water recharge in New Mexico. Technical completion report.** Knowlton, R.G.; Phillips, F.M.; Campbell, A.R. New Mexico State Univ., Las Cruces, NM (USA). New Mexico Water Resources Research Inst. Feb 1989. 99p. (WRRI–237). Available from NTIS, PC A05/MF A01.

New Mexico (especially the southern part of the state) is heavily dependent on ground water for agricultural irrigation, municipal supply, and economic development. The quantification of recharge is thus very important. A technique was presented to model the transport of the stable-isotopes (2)H and (18)O. The model developed here can predict the shape of the stable isotope profiles in the vadose zone, and also quantify the vapor-flux portion of soil-water movement. Through a nonlinear least-squares approach, the model is matched to an observed isotope profile by optimizing the values of specified variables. The optimized parameters are then used to numerically solve for the vapor flux as a percentage of the deep flux of water below the root zone. The technique of modeling the isotope species transport is much more robust than conventional heat and moisture flow-modeling techniques. The conclusion stems from the fact that the effective isotopic diffusivities vary little with water content, whereas hydraulic diffusivity is strongly dependent on water content. Based upon the model results, in the top 2.7 meters of the soil profile a depth-averaged estimate of 15 to 33% of the total soil-water movement is in the vapor phase. This implies that the liquid flux of water is most important in the recharge process.

46187 (PB–89-194385/XAB) **Economic benefit considerations in selecting water-quality projects: Insights from the Rural Clean Water Program. Staff report.** Piper, S.; Magleby, R.S.; Young, C.E. Economic Research Service, Washington, DC (USA). Resources and Technology Div. May 1989. 34p. (AGES–89-18). Available from NTIS, PC A03/MF A01.

The Rural Clean Water Program was initiated in 1980 to demonstrate the effectiveness of improved agricultural land management practices in enhancing water quality. Projects that preserve or improve water quality in a heavily used lake or estuary appear to have the greatest potential for generating net benefits. This appears particularly true for projects with recreational or commercial fishing impairments. About a third of the projects have good prospects for generating net benefits under current circumstances.

5206 Regulations

Refer also to citation(s) 44826, 46138, 46139, 46153

46188 (PB–89-204770/XAB) **Superfund Record of Decision (EPA Region 2): Montgomery Township Housing Development, New Jersey (second remedial action), June 88. Final report.** Environmental Protection Agency, Washington, DC (USA). Office of Emergency and Remedial Response. 30 May 1988. 63p. (EPA/ROD/R–02-88/060). Available from NTIS, PC A04/MF A01.

The Montgomery Township Housing Development (MTHD) site is located in Somerset County, New Jersey. The Rocky Hill Municipal Wellfield (RHMW) Superfund site is also covered by the remedial action because of its proximity to the MTHD and the similarity of the contaminants present. The 72-acre MTHD site is a development which includes 71 private homes, with an additional 6 homes affected by the contamination in the surrounding residential areas. The RHMW consists of a two-acre tract of land in the Borough of Rocky Hill, which supplies public water to the residents of Rocky Hill. The selected remedial action for this site includes: ground water pump and treatment using air stripping and reinjection of the treated water back into the aquifer.

53 ENVIRONMENTAL–SOCIAL ASPECTS OF ENERGY TECHNOLOGIES

5301 Social and Economic Studies

Refer also to citation(s) 45176

46189 (UW/GLI–EN57-27-1987-03) **Implications of climatic change for navigation and power generation in the Great Lakes. Summary of Great Lakes Institute reports.** Sanderson, M. Windsor Univ., ON (Canada). Great Lakes Inst. 1987. 53p. (In English and French). (MICROLOG–89-03274). Available from Climate Program Office, Canadian Climate Centre, 4905 Dufferin Street, Downsview, ON, CAN N9B 3P4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

As part of a series of studies investigating the impact of climate warming expected from the greenhouse effect due to a doubling in atmospheric carbon dioxide a specific climate change scenario, and hydrologic and economic models, examined the impacts on Great Lakes navigation and power generation. The mean temperature increase in such a scenario is expected to be about 4.5 degrees C. Mean lake levels may be reduced 30-80 cm and mean flows in the connecting channels may be reduced by up to 20%. If climatic change and increased consumptive use of Great Lakes water occur, low levels would occur in 8 years out of 10. Maximum ice cover may decline to 0% for all lakes except Erie (whose cover would decline to 50%), permitting an 11 month ice-free shipping season. Average annual costs to shipping companies for the 4 principal cargoes (iron ore, grain, coal, and limestone) may increase about 30%. Shipping costs may equal or exceed those of the period of low lake levels of 1963-65 in 9 years out of 10. For the Canadian hydroelectric generating stations on the lakes, climatic change plus increased consumptive use could result in a loss of 4165 GWh of power generation. Replacing the lost production with a mix of nuclear and fossil fuel generation could cost $111 million in 1984 Canadian dollars. Warmer temperatures will result in a lower demand for energy in winter and a slight decrease in summer, resulting in an average annual saving of $172-204 million (1984 Canadian dollars). 7 figs., 3 tabs.

5302 Assessment of Energy Technologies

Refer also to citation(s) 45307

55 BIOMEDICAL SCIENCES, BASIC STUDIES

Refer also to citation(s) 45863

46190 X-ray Fourier-transform holographic microscope. Haddad, W.S. (MCR Technology Corporation, Chicago, IL (USA)); Cullen, D.; Solem, J.C.; Boyer, K.; Rhodes, C.K. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract FG02-86ER13610. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The properties of an x-ray Fourier-transform holographic instrument suitable for imaging hydrated biological samples are described. Recent advances in coherent x-ray source technology are making diffraction-limited holograms of microscopic structures, with corresponding high spatial resolution, a reality. A high priority application of snapshot x-ray holography is the study of microscopic biological structures in the hydrated living state. X-rays offer both high resolution and high contrast for important structures within living organisms, thereby rendering unnecessary the staining of specimens, essential for optical and electron microscopy. If the wavelength is properly chosen. Furthermore, the snapshot feature, arising from picosecond or subpicosecond exposure times, eliminates blurring occurring from either thermal heating or normal biological activity of the sample. Finally, with sufficiently high photon fluxes, such as those available from x-ray lasers, the x-ray snapshot can be accomplished with a single pulse, thereby yielding complete three-dimensional information on a sample having normal biological integrity at the moment of exposure. 10 refs., 6 figs.

46191 First images from the Stanford tabletop scanning soft x-ray microscope. Trail, J.A. (Stanford Univ., CA (USA)); Byer, R.L. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract AC03-76SF00098. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors have constructed a scanning soft x-ray microscope which uses a laser-produced plasma as the soft x-ray source and normal incidence multilayer coated mirrors in a Schwarzschild configuration as the focusing optics. The microscope operates at a wavelength of 140 Å, has a spatial resolution of 0.5 μm, and has a soft x-ray photon flux through the focus of $10^4 s^{-1}$ when operated with only 170 mW of average laser power. The microscope is compact; the complete system, including the laser, fits on a single optical table. In this paper they describe the microscope and present images of metallic microstructures.

46192 X-ray holographic microscopy: Improved images of zymogen granules. Jacobsen, C. (Lawrence Berkeley Lab., CA (USA)); Howells, M.; Kirz, J.; McQuaid, K.; Rothman, S. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract AC02-76CH00016. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Soft x-ray holography has long been considered as a technique for x-ray microscopy. It has been only recently, however, that submicron resolution has been obtained in x-ray holography. This paper will concentrate on recent progress that has been made in obtaining reconstructed images of improved quality. 15 refs., 6 figs.

46193 Amplitude- and phase-contrast x-ray microscopy. Schmahl, G. (Univ. of Goettingen (Germany, F.R.)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

X-ray photons in the wavelength range of about 0.5 - 5 nm are best suited for x-ray microscopy. In the wavelength range $\lambda \gtrsim 2.5$ nm the absorption cross sections are about one order of magnitude smaller than the cross sections for electrons in the energy range in which electron microscopy is performed. These absorption cross sections for soft x-rays are appropriate for high resolution investigation of biological specimens in their natural state having a thickness of up to about 10 micrometer. Especially interesting is the wavelength range between the K absorption edges of oxygen (λ = 2.34 nm) and carbon (λ = 4.38 nm) because in this wavelength range

the radiation is weakly absorbed by water but strongly absorbed by organic matter resulting in a rather good amplitude contrast of wet specimens. For many elements and wavelengths phase shift is the dominating process and not photoelectric absorption. That means that phase-contrast x-ray microscopy can be performed with the following advantages compared to x-ray microscopy modes using amplitude contrast: For wavelengths larger than the carbon K-edge, the amplitude contrast of organic material surrounded by water is very low. To the contrary, for wavelengths slightly larger than CKα the phase contrast of such an object is high. Even in the wavelength range between the K-edges of carbon and oxygen (water window) wavelengths are found for which imaging in phase contrast is better concerning contrast and dosage compared to amplitude contrast imaging. In addition, imaging with phase contrast can be extended to wavelengths of about 0.5 nm with a dosage comparable to that necessary for imaging with amplitude contrast in the water window. The last point may be of practical importance in future work because with shorter wavelengths thicker specimens can be investigated than up to now. 3 refs.

46194 X-ray holography: X-ray interactions and their effects. London, R.A. (Univ. of California, Livermore (USA)); Trebes, J.E.; Rosen, M.D. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-48. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors summarize a theoretical study of the interactions of x-rays with a biological sample during the creation of a hologram. The choice of an optimal wavelength for x-ray holography is discussed, based on a description of scattering by objects within an aqueous environment. The problem of the motion resulting from the absorption of x-rays during a short exposure is described. The possibility of using very short exposures in order to capture the image before motion can compromise the resolution is explored. The impact of these calculation on the question of the feasibility of using an x-ray laser for holography of biological structures is discussed. 12 refs., 2 figs.

46195 Soft x-ray lenses with 400 Å outer zone width. Vladimirsky, Y. (Univ. of California, Berkeley (USA)); Kern, D.; Chang, T.H.P.; Meyer-Ilse, W.; Guttmann, P.; Greinke, B.; Attwood, D. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Fresnel zone plate lenses for focussing and imaging radiation in the 10-50 Å wavelength region have been fabricated with outer zone widths as small as 400 Å. The zone plates were fabricated by electron beam lithography using a high resolution vector scan system designed specifically for nanometer pattern writing. A special circular pattern generation technique, utilizing high speed polar/cartesian conversion was utilized. Field size was calibrated for squareness and orthogonality using electron beam lithography calibration marks and laser interferometry. Patterns were written in a 180-200 nm thick PMMA resist on a 30 nm gold electroplating base. The substrate was a 100 nm silicon nitride film. The pattern received a dose of 250 $\mu C/cm^2$ at 25 KeV. Special patterns requiring a thick central stop region, received a doubled dose, followed by a double development/double plating technique. A method utilizing the phenomenon of form birefringence was used for monitoring the development of the fine features. In the optical microscope with polarized light and crossed analyzer, a distinct change of the reflected intensity is observed during the final stages of development. Text patterns imaged at 45 Å wavelength demonstrate a spatial resolution approaching 500 Å. Measurements of zone plate efficiency are also described.

46196 (LA-UR–89-2456) **Computer symbiosis: Emergence of symbiotic behavior through evolution.** Ikegami, Takashi; Kaneko, Kunihiko. Los Alamos National Lab., NM (USA). [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8905201–1: Conference on emergent computation, 22-26 May 1989). Order Number DE89015247/JAW. Available from NTIS, PC A02/MF A01 - OSTI.

Symbiosis is altruistic cooperation between distinct species. It is one of the most effective evolutionary processes, but its dynamics are not well understood as yet. A simple model of symbiosis is introduced, where we consider interactions between hosts and parasites and also mutations of hosts and parasites. It is found that a symbiotic state emerges for a suitable range of mutation rates. The symbiotic state is not static, but dynamically oscillates. Harmful parasites violating symbiosis appear periodically, but are rapidly extinguished by hosts and other parasites, and the symbiotic state is recovered. The emergence of "Tit for Tat" strategy to maintain symbiosis is discussed. 4 figs.

46197 (LA-UR–89-2618) **Core evolution: Emergence of cooperative structures in a computational chemistry.** Rasmussen, S.; Feldberg, R.; Hindsholm, M.; Knudsen, C. Los Alamos National Lab., NM (USA). 1989. 44p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8905201–2: Conference on emergent computation, 22-26 May 1989). Order Number DE89016605/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have developed an artificial ecology in the computer core, where one is able to evolve assembler-automaton code without any predefined evolutionary path. The system, in the present version has one dimension, is updated in parallel, the instructions are only able to communicate locally, and the system is continuously subjected to noise. The system also has a notion of computational resources. Depending on the specified parameters and the level of complexity of distance from a randomized core, this electronic garden is started at, we see different evolutionary paths. For several initial conditions the system is able to develop extremely viable cooperative programs (organisms ?) which totally dominates the core. This demonstrates the emergence of complex functional properties in a computational environment. 21 refs., 7 figs., 2 tabs.

46198 (ORNL–6545) **Biomedical and Environmental Sciences Program publications 1988.** Johnson, C.A.; Deaton, D.H.; Ellis, J.R.; Norman, V.S.; Rader, K.J.; Rhew, D.H. Oak Ridge National Lab., TN (USA). Jun 1989. 82p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015644/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This bibliography contains more than 600 references to journal articles, books, book chapters and proceedings, reports, abstracts, newsletters, and miscellaneous documents published during 1988 under Oak Ridge National Laboratory Biomedical and Environmental Sciences programs. The list includes publications authored by members of the Biology Division, Environmental Sciences Division, and Health and Safety Research Division in addition to those authored by members of divisions that receive funding through the Associate Laboratory Director for Biomedical and Environmental Sciences. A number of 1987 references that were not entered into the Laboratory Records data base in time for the previous publication are also included in this document. The bibliography is organized by publication type (i.e., journal articles, books, etc.), then by division, and within each division, alphabetically by the senior author. Indexes for journals and for authors are also provided. More than 270 journal articles were published in 1988. Most of these articles appeared in refereed journals, which is an excellent indication of the importance of subject matter and of thoroughness in presentation. Publications not appearing in this document include theses, dissertations, book reviews, most documents or reports prepared for internal distribution, letters to editors, and abstracts published in nonreferenced sources.

5502 Biochemistry

Refer also to citation(s) 45625, 46208, 46210, 46211

46199 Identification of DNA repair genes in the human genome. Hoeijmakers, J.H.J. (Erasmus Univ., Rotterdam (Netherlands)); van Duin, M.; Westerveld, A.; Yasui, A.; Bootsma, D. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; 28 May - 4 jun 1986.

To identify human DNA repair genes we have transfected human genomic DNA ligated to a dominant marker to excision repair deficient xeroderma pigmentosum (XP) and CHO cells. This resulted in the cloning of a human gene, ERCC-1, that complements the defect of a UV- and mitomycin-C sensitive CHO mutant 43-3B. The ERCC-1 gene has a size of 15 kb, consists of 10 exons and is located in the region 19q13.2-q13.3. Its primary transcript is processed into two mRNAs by alternative splicing of an internal coding exon. One of these transcripts encodes a polypeptide of 297 aminoacids. A putative DNA binding protein domain and nuclear location signal could be identified. Significant AA-homology is found between ERCC-1 and the yeast excision repair gene RAD10. 58 references, 6 figures, 1 table.

46200 (CONF-8907131–1) **Unusual hydrogen bonding patterns in AF [aminofluorene] and AAF [acetylaminofluorene] modified DNA.** Broyde, S.; Hingerty, B.E.; Shapiro, R.; Norman, D. Oak Ridge National Lab., TN (USA). [1989]. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 4. international conference on N-substituted aryl compounds: occurrence, metabolism and biological impact of nitroarenes; 15-19 Jul 1989. Order Number DE89015985/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

New structures are presented for AF and AAF modified DNAs that place the carcinogen in the minor groove of a B-DNA helix. These structures employ non-Watson-Crick base pairing schemes with syn guanine at the modification site. 32 refs., 9 figs.

46201 (CONF-8908117–1) **Function of active-site residues of ribulose-bisphosphate carboxylase/oxygenase (Rubisco).** Hartman, F.C.; Lee, E.H.; Smith, H.B. Oak Ridge National Lab., TN (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 8. international congress on photosynthesis; 6-11 Aug 1989. Order Number DE89016264/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Chemical modification, site-directed mutagenesis, and x-ray crystallography have identified Lys166, Lys329, and Glu48 as active-site residues of the homodimeric Rubisco from Rhodospirillum rubrum. (In the L_8S_8 Rubisco from spinach, these residues correspond to Lys175, Lys334, and Glu60.) We have used two strategies to explore the function of these residues: (a) introduction of very subtle structural changes into their side chains by combining chemical modification with site-directed mutagenesis and (b) evaluation of the ability of mutant proteins, devoid in overall carboxylase activity, to catalyze the enolization of D-ribulose-1,5-bisphosphate (RuBP), i.e. the first step in the normal reaction pathway. 15 refs., 2 figs.

46202 (LBL–25981) **Neural networks and the human genome project.** Smith, S.D.G.; Hutchinson, M.S.; Flies, M.A. Lawrence Berkeley Lab., CA (USA). Feb 1989. 37p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89016025/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Many of the computing problems involved in the human genome project fall into the category of problems that a neural network might be expected to solve, including: the prediction of splice junctions in DNA sequences, the prediction of secondary and tertiary structures of proteins, and the categorization of gels. This project was a summer undergraduate computer science project under the direction of the second author. The objective of this 10 week project was to explore how neural networks operate, what things affect this operation, and where they can plat a role in the human genome project. The neural network software was written or modified by the first author. The third author was responsible for the programs to access the Genbank DNA sequence databank. 9 refs., 14 figs.

46203 (LBL–27205) **In vivo and in vitro replication studies of a mutant SV40 virus isolated from transformed human cells.** Maulbecker, C.C. Lawrence Berkeley Lab., CA (USA). Apr 1989. 227p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89016317/JAW. Available from NTIS, PC A11/MF A01 - OSTI; GPO Dep.

We report here that both GM637 and XP12ROSV harbor much higher numbers of extrachromosomal SV40 genomes than originally measured for GM637 (an average 100 copies of SV40 DNA/cell in GM637). Previous studies of GM637 have focused only on the state of the integrated viral DNA but not the extrachromosomal DNA. This chapter describes a thorough study of the GM637 and XP12ROSV extrachromosomal SV40 genomes, which we designate GMSV40 and XPSV40, respectively. The finding of extrachromosomal SV40 genomes in XP12RO complementation group A cells is especially intriguing as these cells are defective in DNA repair and have been used widely to study the effect of chemical DNA damaging agents and uv irradiation on DNA. Most but not all XP complementation groups have been shown to efficiently replicate viral DNA. The transformed daughter cell line XP12ROSV would thus be expected to be incapable of excising the integrated SV40 DNA, while being able to replicate exogenous SV40 genomes. This may suggest that the excision of integrated SV40 DNA does not occur and that XPSV40 comes from an extrachromosomal genome. 176 refs.

46204 (LBL-PUB–657/6-89) **Mapping the human genome.** Lawrence Berkeley Lab., CA (USA). Jun 1989. 23p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89016316/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The following pages aim to lay a foundation for understanding the excitement surrounding the "human genome project," as well as to convey a flavor of the ongoing efforts and plans at the Human Genome Center at the Lawrence Berkeley Laboratory. Our own work, of course, is only part of a broad international effort that will dramatically enhance our understanding of human molecular genetics before the end of this century. In this country, the bulk of the effort will be carried out under the auspices of the Department of Energy and the National Institutes of Health, but significant contributions have already been made both by nonprofit private foundations and by private corporation. The respective roles of the DOE and the NIH are being coordinated by an inter-agency committee, the aims of which are to emphasize the strengths of each agency, to facilitate cooperation, and to avoid unnecessary duplication of effort. The NIH, for example, will continue its crucial work in medical genetics and in mapping the genomes of nonhuman species. The DOE, on the other hand, has unique experience in managing large projects, and its national laboratories are repositories of expertise in physics, engineering, and computer science, as well as the life sciences. The tools and techniques the project will ultimately rely on are thus likely to be developed in multidisciplinary efforts at laboratories like LBL. Accordingly, we at LBL take great pride in this enterprise – an enterprise that will eventually transform our understanding of ourselves.

46205 Radioiodinated branched carbohydrates. Goodman, M.M.; Knapp, F.F. Jr. To Dept. of Energy, Washington, DC. USA Patent 4,826,966. 2 May 1989. Filed date 31 Mar 1988. 6p. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

A radioiodinated branched carbohydrate for tissue imaging. Iodine-123 is stabilized in the compound by attaching it to a vinyl functional group that is on the carbohydrate. The compound exhibits good uptake and retention and is promising in the development of radiopharmaceuticals for brain, heart and tumor imaging.

46206 Electrophoretic extraction of proteins from two-dimensional electrophoresis gel spots. Zhang, J.S.; Giometti, C.S.; Tollaksen, S.L. To Dept. of Energy, Washington, DC. USA Patent 4,824,547. 25 Apr 1989. Filed date 4 Sep 1987. 13p. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

After two-dimensional electrophoresis of proteins or the like, resulting in a polyacrylamide gel slab having a pattern of protein gel spots thereon, an individual protein gel spot is cored out from the slab, to form a gel spot core which is placed in an extraction tube, with a dialysis membrane across the lower and of the tube. Replicate gel spots can be cored out from replicate gel slabs and placed in the extraction tube. Molten agarose gel is poured into the extraction tube where the agarose gel hardens to form an immobilizing gel, covering the gel spot cores. The upper end portion of the extraction tube is filled with a volume of buffer solution, and the upper end is closed by another dialysis membrane. Upper and lower bodies of a buffer solution are brought into contact with the upper and lower membranes and are provided with electrodes connected to the positive and negative terminals of a DC power supply, thereby

producing an electrical current which flows through the upper membrane, the volume of buffer solution, the agarose, the gel spot cores and the lower membrane. The current causes the proteins to be extracted electrophoretically from the gel spot cores, so that the extracted proteins accumulate and are contained in the space between the agarose gel and the upper membrane. A high percentage extraction of proteins is achieved. The extracted proteins can be removed and subjected to partial digestion by trypsin or the like, followed by two-dimensional electrophoresis, resulting in a gel slab having a pattern of peptide gel spots which can be cored out and subjected to electrophoretic extraction to extract individual peptides.

5503 Cytology

46207 Cytogenetic analysis by in situ hybridization with fluorescently labeled nucleic acid probes. Pinkel, D. (Lawrence Livermore National Laboratory, CA (USA)); Gray, J.W.; Trask, B.; van den Engh, G.; Fuscoe, J.; van Dekken, H. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). DOE Contract W-7405-ENG-48. From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; 28 May - 4 jun 1986.

The use of probes that are modified chemically rather than radioactively has advantages for chromosome labeling. Hybridization is detected with reagents that bind with high affinity to the chemically modified probe and carry various types of reporter molecules. In addition discrimination of the hybridization of more than one probe to the same target becomes possible by using a different chemical modification and reporting molecule for each probe. We have focused on the use of fluorescent labeling because it is particularly suited for quantitative analysis through intensity measurement and high-resolution imaging. We call this procedure fluorescence hybridization. In this paper we demonstrate the application of fluorescence hybridization to the: rapid screening of interspecies hybrid cell lines for retained chromosomes and chromosomal rearrangements; use of human chromosome-specific probes to label selected chromosomes in interphase nuclei; study of the three-dimensional chromosomal organization in nuclei; and flow cytometric measurement of hybridization to human cell nuclei. 31 references, 3 figures.

5504 Genetics

Refer also to citation(s) 44899, 46204, 46207, 46326, 46334, 46335

46208 Application of synthetic DNA probes to the analysis of DNA sequence variants in man. Wallace, R.B. (Beckman Research Institute of the City of Hope, Duarte, CA (USA)); Petz, L.D.; Yam, P.Y. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; 28 May - 4 jun 1986.

Oligonucleotide probes provide a tool to discriminate between any two alleles on the basis of hybridization. Random sampling of the genome with different oligonucleotide probes should reveal polymorphism in a certain percentage of the cases. In the hope of identifying polymorphic regions more efficiently, we chose to take advantage of the proposed hypermutability of repeated DNA sequences and the specificity of oligonucleotide hybridization. Since, under appropriate conditions, oligonucleotide probes require complete base pairing for hybridization to occur, they will only hybridize to a subset of the members of a repeat family when all members of the family are not identical. The results presented here suggest that oligonucleotide hybridization can be used to extend the genomic sequences that can be tested for the presence of RFLPs. This expands the tools available to human genetics. In addition, the results suggest that repeated DNA sequences are indeed more polymorphic than single-copy sequences. 28 references, 2 figures.

46209 DNA-based detection of chromosome deletion and amplification: diagnostic and mechanistic significance. Latt, S.A. (Harvard Medical School, Boston, MA (USA)); Lalande, M.; Donlon, T.; Wyman, A.; Rose, E.; Shiloh, Y.; Korf, B.; Mueller, U.; Sakai, K.; Kanda, N. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; 28 May - 4 jun 1986.

This paper describes a few of the many possible examples in which application of a molecular cytogenetic approach can ultimately lead to a new, important understanding about the statics and dynamics of human chromosome structure. In the case of retinoblastoma, cytological observations of deletions and linkage analysis have positioned the retinoblastoma locus to bank 13q14. This locus is grossly deleted in some spontaneous tumors. It is still necessary to locate more precisely and characterize the nature of the retinoblastoma locus, as well as the basis for the heterogeneity in deletions removing one copy of this locus. One is left with the possibility that those deletions that may be observed cytologically reflect but the tip of the iceberg of deletions; detection of others may require molecular probes. A related question is the nature of the DNA sequences at the deletion boundaries and the role they play in promoting these deletions.

46210 Repetitive human DNA sequences. I. Evolution of the primate α-globin gene cluster and interspersed alu repeats. II. Properties of a transposon-like human element. Sawada, I. (Univ. of California, Davis (USA)); Schmid, C.W.; Deka, N.; Paulson, K.E.; Willard, C. pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; 28 May - 4 jun 1986.

A repetitive family of human sequences is similar to transposons yeast Ty, Drosophilla copia, and mammalian proretrovirus. In human THE-family consists of 10,000 copies sharing a 2 Kb consensus sequence. Members of this family are flanked by short direct repeats, suggesting THE-1 elements insert into preferred target sites. THE-1 elements are present in extrachromosomal closed circular DNAs. Both transcriptional senses are represented in poly A plus RNAs as well as polysome bound RNAs. In one case, a THE-1 element processes the 3' end of a transcript resulting from an upstream promoter. A 4 Kb transcript, which is specific to Hela cells, results from insertion of a THE-1 element into this transcription unit. Monkey, chimpanzee and human share repetitive THE-1 families having a similar consensus sequence including orthologous member sequences. Parts of the THE-1 human sequence are present as single copy sequence elements in a lower primate, galago. Conceivable these single copy sequence elements result from ancestral sequences which rearranged prior to their successful amplification in the human genome. The structure of the galago alpha globin gene cluster more nearly resembles the structure of this region in such mammals as goat and horse rather than the structure in higher primates. The Alu family repeats in human and galago result from entirely independent insertion events. In contrast higher primates, human, chimpanzee and monkey, share orthologous Alu repeats. The divergence of these orthologous Alu repeats approximates the value expected for non selected DNA sequences. 34 references, 7 figures.

46211 Human genome and its evolutionary context. Bernardi, G. (Institut Jacques Monod, Paris (France)). pp. 702 of Cold Spring Harbor symposia on quantitative biology. Volume 51, Molecular biology of Homo sapiens. Cold Spring Harbor Laboratory, Cold Spring Harbor, NY (1986). From 51. Cold Spring Harbor symposium on quantitative biology: molecular biology of Homo sapiens; 28 May - 4 jun 1986.

The nuclear genome of man, like those of all warm-blooded vertebrates, exhibits a compositional compartmentalization, in that it mainly consists of a mosaic of very long (>>200 Kb) DNA segments, which belong to a small number of classes characterized by different GC levels. The families of DNA molecules derived from these classes can be separated and used to study the genome distribution of any sequence that can be probed. This approach has revealed the distribution of genes in the genomes of warm-blooded vertebrates. In the human genome the GC levels of both coding and non-coding sequences show a linear dependence on the GC levels of the isochores harboring the sequences. The latter observation prompted a study of the compositional constraints operating on

over 60 genomes from a very wide range of organisms. This work concerns that the effects of compositional constraints on codon usage as well as on the structure, stability and function of DNA, RNAs and proteins; the causes of compositional constraints and the processes underlying the fixation of mutations; the neutralist-selectionist controversy; and the nature of the organismal phenotype. 43 references, 4 figures, 2 tables.

5505 Metabolism

Refer also to citation(s) 44423, 44834

46212 (INIS-mf-11479) **Application of nuclear technique for dynamic study in animal research.** Mohamad Aziz Dollah. Malaysian Agricultural Research and Development Inst., Serdang, Selangor (Malaysia). 1987. 3p. (CONF-8711314--: Seminar on the application of nuclear techniques in industry, 17 Nov 1987). Order Number DE89635255/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI.

This paper discusses the basic principle used for the study of the dynamic of biological compound in vivo using radioisotope with particular reference to water requirement study on farm animals. Some results of the study using the technique are also presented.

46213 Glycation of calmodulin: Chemistry and structural and functional consequences. Kowluru, R.A. (Los Alamos National Lab., NM (USA)); Heidorn, D.B.; Edmondson, S.P.; Bitensky, M.W.; Kowluru, A.; Downer, N.W.; Whaley, T.W.; Trewhella, J. *Biochemistry (USA)*, 28(5): 2220-2228 (7 Mar 1989).

In the presence of Ca2+ and glucose, calmodulin incorporates 2.5 mol of glucose/mol of protein. In the absence of Ca2+, only 1.5 mol of glucose is incorporated per mole of calmodulin. Glycation of calmodulin is associated with variable reductions in its capacity to activate three Ca2+/calmodulin-dependent brain target enzyme systems, including adenylyl cyclase, phosphodiesterase, and protein kinase. In addition, glycated calmodulin exhibits a 54% reduction in its Ca2+ binding capacity. Isolated CNBr cleavage fragments of glycated calmodulin suggest that glycation follows a nonspecific pattern in that each of seven available lysines is susceptible to modification. A limit observed on the extent of glycation appears related to the accompanying increase in negative charge on the protein. Glycation results in minimal structural rearrangements in calmodulin, and the Ca2+-induced increase in alpha-helix content and radius of gyration is the same for glycated and unmodified calmodulin. Since glycated calmodulin's Ca2+ binding capacity is reduced, this implies that the Ca2+-induced conformational changes in calmodulin do not require all four Ca2+ binding sites to be occupied. Examination of the lysine positions in calmodulin suggests that Ca2+ binding to domains II and IV is sufficient to induce these changes. The functional consequences of calmodulin glycation therefore cannot be attributed to inhibition of these conformational changes. An alternative explanation is that the inhibition arises from interference at the target enzyme binding site by bound glucose. While glycation shows minimal structural effects, a large pH dependence is observed for the alpha-helix content of unmodified calmodulin.

5506 Medicine

Refer also to citation(s) 45728, 45736, 45863, 46190, 46191, 46192, 46193, 46194, 46202, 46282, 46283

46214 Fractionation considerations for boron neutron capture therapy: The perspective of a clinician. Meek, A.G. (University Hospital at Stony Brook, NY (USA)). pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102--: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Fractionation is the cornerstone of modern megavoltage photon therapy. The sparsely ionizing nature of x-ray therapy seems to necessitate fractionation for successful sterilization of malignant tumors. However, high-LET, densely ionizing radiations such as neutrons or alpha particles are less dependent on fractionation for their success. In this context, the advantages and disadvantages of fractionation for boron neutron capture therapy for malignant gliomas are evaluated.

46215 Swine skin: A model to evaluate dose recovery from different radiations. Archambeau, J.O. (Loma Linda Univ., CA (USA)). pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102--: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

A swine skin model was selected to quantify the tissue dose response produced by the thermal neutron beam, adventitious radiations and boron-10 radiations used in the BNL clinical trials. This model was chosen because the irradiation geometry, anatomy with a subcutaneous fat layer, histology and known response to irradiation all approached that found in humans. The study quantified the parameters in the swine skin at gross, histologic, morphologic, cytologic, and kinetic levels and also simulated the radiation changes. The gross and histologic dose response to single-dose fractions of thermal neutrons, degraded fission neutrons and X rays, the dose response to multiple dose fractions of X rays and the $^{10}B(n,\alpha)^{7}Li$ reaction were compared. This paper lists the absorbed doses at which 50% of the irradiated fields were not healed (ED-50), the dose ratios, and the dose recovery values obtained in the post-clinical studies. The model will be used to obtain a preclinical appraisal of the dose distribution expected to be produced in humans using the optimized epithermal neutron beams on skin containing a range of boron-10 concentrations from compounds of clinical interest.

46216 Research on neutron capture therapy in the USSR. Ryabukhin, Y. (World Health Organization, Geneva (Switzerland)). pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102--: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Research on neutron capture therapy in the USSR began in 1964. Towards 1975 prime knowledge in physics, pharmacology and radiobiology had been accumulated. It was realized that inherent to NCT is a variety of modalities as to the type and location of the tumor, the energy and source of neutrons, the nature and transportation of the nuclide-carrying agent (NCA), etc. Thus, it became likely that some modalities would turn out to be clinically feasible. At the end of the 70s, studies of boron derivatives began at the All-Union Oncological Research Center, Moscow. These studies were stimulated by the clinical trials in Japan. Still, neutron capturing nuclides (NCN) other than ^{10}b are regarded as promising. Research was aimed at clinical trials that could ensure sufficient safety, convenience and conclusiveness. Hence, new requirements emerged, such as the pre-clinical modeling of NCT in big animals and the monitoring of tumor response to each fraction of NCT. Usual requirements are also to be met, that is: tailoring neutron beams with an adequate intensity and energy, choosing NCNs and finding suitable NCAs, physical and radiobiological planning including adoption of tentative RBEs and time-fractionation regimen, selecting tumors as candidates for NCT, and developing techniques for monitoring NCNs in vivo.

46217 BNCT project in Czechoslovakia. Burian, J. (Institute of Nuclear Research, Prague (Czechoslovakia)); Janku, I.; Kvitek, J.; Mares, V.; Prouza, Z.; Spurny, F.; Sourek, K.; Stibr, B.; strouf, O. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102--: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

In Czechoslovakia, a multidisciplinary research group for BNCT of human brain gliomas has been constituted in 1980. Mercaptoborane compound has been synthesized suitable for clinical use. The configuration of a thermal neutron beam with appropriate parameters has been created using the 10 MW VVR-S research reactor and proved experimentally. The realization of a technical project for a clinical pilot study could be expected by 1992.

46218 Proposed clinical trial studying the pharmacokinetics of B.S.H. Harkness, W.F.J. (Radcliffe Infirmary, Oxford (England)).

pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

There has been considerable interest in BNCT at Oxford for several years, which has been facilitated by the proximity of the clinical Departments of Neurosurgery and Radiotherapy as well as the Radiobiology unit and the Atomic Energy Research Establishment at Harwell. Each unit has been collaborating over this time with the end objective of a therapeutic facility at Harwell. In the Department of Neurosurgery, they are about to embark on a clinical study of the pharmacokinetics of a boron compound. This is a non-therapeutic trial as they cannot offer a neutron facility at Harwell as yet. Full approval of the Ethical Committee has been granted.

46219 Fractionation in boron neutron capture therapy. Durrant, K.R. (Churchill Hospital, Oxford (England)); Hopewell, J. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

In BNCT there are three major radiation products: the high-LET alpha particles of the $B(n,\alpha)Li$ reaction, the recoil protons from the incident neutron beam in non-borated tissue, and the low-LET gamma radiation, both from the treatment beam and from that induced in the reaction. Damage from the gamma radiation component is likely to be considerably reduced by fractionation. If a differential concentration of boron between tumor cells, normal nervous tissue cells and blood and endothelial cells is achieved, there would be a ten-fold differential dose to tumor versus normal tissue cells. Most radiation damage of non-borated tissue would arise from gamma radiation with the proton recoil effect dependent upon the energy of the neutron beam. The most significant difference between neutron and photon irradiation is the greater biological effectiveness of neutrons, associated with the reduction of repairable sublethal damage. These affect both total dose and fractionation. For very high-LET radiation, radiobiological data suggests that fractionation would not reduce radiation damage. However, data for neutron irradiation at c.16 MeV suggest that for both spinal cord and skin, the fractionation of the neutron dose of 4 to 6 fractions results in increased repair of sublethal damage, but that further fractionation would not reduce late radiation damage significantly.

46220 Dose fractionation in neutron capture therapy for malignant melanoma. Allen, B.J. (Australian Nuclear Science and Technology Organization, Menai, New South Wales); Brown, J.K. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Australia is entering a joint clinical trial with Japan for thermal neutron capture therapy of selected patients with superficial local recurrent, local advanced and isolated metastatic malignant melanoma. The para-boronophenylalanine (BPA) compound will be used with a neutron fluence of about 10^{13} neutrons per cm^2, to be delivered in a single dose. While in the initial trials of NCT, the single dose is a practical procedure; there may be advantages in dose fractionation, and these are considered in this paper.

46221 Thermal neutron capture therapy: The Japanese-Australian clinical trial for malignant melanoma. Allen, B.J. (Australian Nuclear Science and Technology Organization, Menai, New South Wales); Coates, A.S.; McCarthy, W.H.; Mameghan, H.; Mishima, Y.; Ichihashi, M. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Following the first NCT treatment for melanoma last year in Japan, it is planned to treat at least 12 patients during 1988, from Australia and Japan. Patients will be selected from those having evaluable superficial or subcutaneous local recurrence or isolated metastasis. In addition, selected Japanese patients with thick primary acral-lentiginous melanoma or superficially spreading melanoma that have poor prognosis with conventional therapy will be treated with NCT. Australian patients will be selected from those attending the Sydney Melanoma Unit at Royal Prince Alfred Hospital. They will have no detectable deep-seated distant metastases and should have an estimated life expectancy of at least 6 months. Locally recurrent or advanced melanoma are rare conditions, thanks to the increased awareness of the public and general practitioners and to the more stringent procedures adopted by surgeons.

46222 BNCT and dose fractionation. Russell, J.L. Jr. (Theragenics Corp., Atlanta, GA (USA)). pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Some portion of the radiation dose received by a patient during BNCT consists of primary and secondary gammas. The biological effect of that portion of the dose will depend upon the time history of the delivered dose. The well-known models for relating time-dose effects to clinical experience, are of questionable value in understanding dose effects in the time regime of a few hours, and for doses of less than tolerance. In order to examine the time-dose effect in the regime of interest to BNCT a simple phenomenological model was developed and normalized to the accepted body of clinical experience. The model has been applied to the question of fractionation of BNCT and the results are presented. The model is simply a linear healing model with two time constants. In other words, a first hit of radiation is assumed to wound (or potentiate) a cell. Given time, the cell will fully repair itself. If a second hit occurs before the cell has healed, the cell is killed. Apparently, there are two kinds of healing, one which occurs in 30 to 60 minutes, the other in two to four days. A small fraction of the cells will die on the first hit.

46223 Vascular factors affecting drug delivery to brain tumors. Tyson, G. (State Univ. of New York, Stony Brook (USA)); Fenstermacher, J.; Davis, R. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

This paper will briefly review the vascular factors that are important in selecting an agent for BNCT. In general, these particular factors - tumor blood flow and microvascular permeability - have not been considered critical limiting factors in BNCT. Although the normal cerebral capillary endothelium restricts the transfer of water-soluble drugs from blood to brain, the capillaries of malignant cerebral neoplasms are generally more permeable. Furthermore, blood flow in malignant brain tumors is generally normal or even increased, except in necrotic regions in which drug delivery is considerably less important. Unfortunately, these generalizations may be inadequate for any form of drug therapy which is delivered by the bloodstream and which seeks to entirely eradicate a malignant brain tumor. Available multi-modality treatment programs fail to achieve a cure despite the fact that they can eliminate more than 99.99% of a tumor. Thus, novel forms of therapy are not needed for the vast majority of the tumor cells. Instead, all new forms of therapy, including BNCT, must concentrate on the .01% of tumor cells which are presumably different enough to escape destruction.

46224 A proposed protocol for clinical trials of boron neutron capture therapy in glioblastoma multiforme. Dorn, R.V. III (EG and G Idaho, Inc., Idaho Falls (USA)); Spickard, J.H.; Griebenow, M.L. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). DOE Contract AC07-76ID01570. (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Neutron capture therapy (NCT) was suggested in theory as a treatment for malignant tumors some 50 years ago. Since then, considerable data have accumulated on the mechanisms of action and possible application of this technique. This paper outlines a protocol for a controlled study of the use of boron neutron capture therapy (BNCT) for the treatment of glioblastoma multiforme (GM). The protocol is one component of a comprehensive national BNCT research program at the Idaho National Engineering Laboratory (INEL) directed towards validating (or invalidating) NCT as a treatment for

human malignancies. This paper will address the following three points: provide a background of GM, as a tumor model, including current conventional treatment and research avenues; present an overview and framework of the clinical protocol, and introduce questions on research that may well impact the protocol before it is used, including possible additional tumor systems to be studied.

46225 A stochastic model for high-LET response for boron neutron capture therapy (BNCT). Wheeler, F.J. (EG and G Idaho, Inc., Idaho Falls (USA)); Griebenow, M.L.; Wessol, D.E.; Nigg, D.W.; Anderl, R.A. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). DOE Contract AC07-76ID01570. (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

There is evidence showing that there is a significant variation in tumor-boron and blood-boron concentrations for individual patients. There also is a wide variation in the size and location of the tumor. This diversity creates a situation in which treatment must be carefully tailored to the specific needs of each patient. A stochastic model is required for the $^{10}B(n,\alpha)^{7}Li$ effect. The application of such a model requires a microscopic biological-response function. Research and experience will be required before the models and response functions can be precisely quantified, but useful qualitative information on basic trends can be determined from simple models and trial response functions. This paper describes a proposed model based on the lineal response, which is very applicable to BNCT. The model is not limited to single-event response, but only requires the applicability of a response function which is independent of other events. Experiments support such a model for the $^{10}B(n,\alpha)^{7}Li$ reaction. This paper describes the model, provides details for basic charged-particle information and simulation methods, and provides a simple demonstration of the model's important by evaluating the endothelium tolerance to BNCT.

46226 Distributions of sulfhydryl borane monomer and dimer in rodents and monomer in humans: Boron neutron capture therapy of melanoma and glioma in boronated rodents. Slatkin, D.N.; Joel, D.D.; Fairchild, R.G.; Micca, P.L.; Nawrocky, M.M.; Laster, B.H.; Coderre, J.A.; Finkel, G.C.; Poletti, C.E.; Sweet, W.H. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

In this paper, boron distributions after infusion of monomer into two patients with malignant glioma are summarized. Preliminary studies are described of the effects of BNCT on intracerebral transplanted gliomas in rats infused with ^{10}B-enriched dimer and on subcutaneous transplanted mouse melanoma in mice infused with ^{10}b-enriched dimer or monomer. Distributions of ^{10}b in rats after prolonged intraperitoneal and intravenous infusions of the sulfhydryl boranes are also presented.

46227 A carboranyl porphyrin for boron neutron capture therapy of brain tumors. Kahl, S.B. (Univ. of California, San Francisco (USA)); Joel, D.D.; Finkel, G.C.; Micca, P.L.; Nawrocky, M.M.; Coderre, J.A.; Slatkin, D.N. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Many porphyrins are known to concentrate in tumor tissue both in vivo and in vitro, but the mechanisms of porphyrin-tumor affinity are unknown. A central theme of boron neutron capture therapy (BNCT) research is the search for boronated substances with high affinity for tumor. There is interest in the synthesis of boron-containing porphyrins and their evaluation for possible efficacy in BNCT. This study presents some modifications of a previously described method for synthesis of a particular nidocarboranyl porphyrin and some preliminary experimental indications of its potential usefulness for BNCT.

46228 Distribution of a boronated porphyrin in murine tumors. Kahl, S.B. (Univ. of California, San Francisco (USA)); Laster, B.H.; Koo, M.S.; Warkentien, L.S.; Fairchild, R.G. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

The authors have recently begun studying the boron distribution provided by a newly synthesized, water-soluble, non-toxic, boronated natural porphyrin (SBK-II). Multiple intraperitoneal injections (6 injections, 0.5 ml each, 3 per day over a 2-day period) with a total boron concentration of 20-50 μgB/gbw were administered to female BALB/cBNL mice bearing a Harding-Passey melanoma subcutaneously in the thigh. Boron distribution was determined at various time intervals following the last injection to allow an assessment of tumor uptake and clearance rate for blood and normal tissue. Concentrations of ^{10}boron in tumor and various organs were analyzed by the prompt-γ method. Continuous intravenous infusion techniques were also used to deliver boron to tumor, using the KHJJ mammary tumor model in BALB/c mice.

46229 Survival assays with a boronated porphyrin as measured with hamster V-79 cells in culture. Laster, B.H.; Kahl, S.B.; Popenoe, E.A.; Gordon, C.; Kalef-Ezra, J.; Fairchild, R.G. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

On the basis of their weight, boron-carrying capacity and propensity for tumor, porphyrins would appear to be the ideal carrier-molecules for use in boron neutron therapy (BNCT). In the past, problems such as toxicity, solubility and/or lability of the boron tag precluded the use of porphyrins for BNCT. However, a newly-synthesized boronated porphyrin appears to have surmounted these problems and, in preliminary in vitro studies, SBK-II has demonstrated biological efficacy. Preliminary data will be presented here comparing SBK-II with the monomeric (BSH) and dimeric (BSSB) forms of the sulfhydryl boron hydride currently being considered for use in BNCT clinical trials in the US.

46230 Neutron capture therapy for melanoma. Coderre, J.A.; Glass, J.D.; Micca, P.; Fairchild, R.G. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

The development of boron-containing compounds which localize selectively in tumor may require a tumor-by-tumor type of approach that exploits any metabolic pathways unique to the particular type of tumor. Melanin-producing melanomas actively transport and metabolize aromatic amino acids for use as precursors in the synthesis of the pigment melanin. It has been shown that the boron-containing amino acid analog p-borono-phenylalanine (BPA) is selectively accumulated in melanoma tissue, producing boron concentrations in tumor that are within the range estimated to be necessary for successful BNCT. The authors report here the results of therapy experiments carried out at the Brookhaven Medical Research Reactor.

46231 Tumor-seeking compounds for boron neutron capture therapy: Synthesis and biodistribution. Gabel, D. (Univ. of Bremen (West Germany)). pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

A successful application of boron neutron capture therapy towards the treatment of human malignancies relies on two prime conditions: the delivery of a sufficient amount of neutrons to the target volume, and the delivery of a sufficient amount of boron to the target cells. It must therefore be the aim of the chemist to synthesize tumor-localizing compounds that are able to target all tumor cells, and preferentially such compounds that are internalized by the cells. For a realistic chance of a successful therapy, it might be necessary to administer several compounds that accumulate through independent routes, and thus are able to reach all cells of the tumor. To be able to predict the outcome of a clinical therapy trial with a given boron concentration, it will be necessary to know the location of boron on an intracellular scale. The authors developed a method that allows for the analysis of boron in tissue sections. This method, Quantitative Neutron Capture Radiography (QNCR), utilizes

the selective sensitivity of cellulose nitrate films to the particles generated by the neutron capture reaction in boron.

46232 Boron-11 magnetic resonance imaging and spectroscopy; Tools for investigating pharmacokinetics for boron neutron capture therapy. Kabalka, G.W. (Univ. of Tennessee Institute for Biomedical Imaging, Knoxville (USA)); Bendel, P.; Davis, M.; Slatkin, D.N.; Micca, P.L. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). DOE Contract FG05-86ER60434. (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

MRI and MRS have the capability of providing in vivo information concerning the identity, quantity, and environment of drugs and other physiologically important materials. Significantly, the information is provided in three dimensional space which permits precise, non-invasive localization of the agent of interest. Since boron-11 and boron-10 are magnetically active, MRI and MRS are potentially valuable techniques for evaluation of BNCT agents in vivo. The authors present preliminary MRI and MRS measurements of the sulfhydryl dodecaborane dimer ($B_{24}H_{22}S_2^{-4}$), which include the first boron-11 image of a BNCT agent and the first boron-11 spectrum of a BNCT agent measured in an intact animal.

46233 Selective thermal neutron capture therapy and diagnosis of malignant melanoma: From basic studies to first clinical treatment. Yutaka Mishima (Kobe Univ. School of Medicine (Japan)); Masamitsu Ichihashi; Susumu Hatta; Chihiro Honda; Akihiro Sasase; Keizo Yamamura; Keiji Kanda; Tooru Kobayashi; Hiroshi Fukuda. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

As melanoma genesis occurs in pigment cells, accentuated melanogenesis concurrently occurs in principle. Thus, harnessing this accentuation of melanogenesis, the authors developed a new mutually-dependent two-step therapy, in which melanogenesis-seeking compounds first specifically target melanoma cells, enabling the powerful second step to selectively destroy the targeted cells. Their new thermal neutron capture therapy (NCT) uses a ^{10}B-dopa(melanin substrate) analogue, ^{10}B1-p-boronophenylalanine (^{10}B1-BPA) which accumulates preferentially in melanoma cells. The cells then are irradiated with thermal neutrons to induce the ^{10}b(n, α)^{7}Li reaction which releases energy of 2.33 MeV to a distance of 10-14μ, the diameter of melanoma cells. Extensive in vitro and in vivo radiobiological analysis confirmed the highly enhanced killing effect of ^{10}b1-BPA. Measurements of the accumulating capacity of ^{10}b1-BPA into melanoma cells in vitro and in vivo using both chemical and prompt gamma ray spectrometry assay showed its high affinity for these cells.

46234 Blood-brain-barrier impairment after irradiation: Implication in boron neutron capture therapy. Gregoire, V. (Universite Catholique de Louvain, Brussels (Belgium)); Keyeux, A.; Wambersie, A. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

The rationale of boron neutron capture therapy (BNCT) in brain tumors rests on the assumption that the boronated compounds will not be incorporated in the normal CNS protected by the tight blood-brain barrier (BBB) but will enter the tumor at the level at which the BBB is impaired. If fractionation is to be used in BNCT, or if BNCT would follow external radiotherapy, the question is: to what extent could the fractions (or the previous treatment) alter the BBB? To answer this question, it is necessary to assess the integrity of the BBB after different levels of absorbed dose and different time intervals. A brief summary of the structure and physiology of the BBB in the normal brain and tumor will be presented first, followed by a review of the published data concerning alteration of the BBB after cerebral irradiation.

46235 Implications of genotypic and microenvironmental heterogeneity for the cure of solid tumors by neutron capture therapy. Rockwell, S. (Yale Univ. School of Medicine, New Haven, CT (USA)). pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

There is increasing evidence for genotypic, phenotypic, and microenvironmental heterogeneity within solid tumors in experimental animals and in humans. This heterogeneity influences the response of the tumors to treatment with radiation, cytotoxic drugs, hyperthermia, and immunotherapy, and may also influence the efficacy of neutron capture therapy. This paper reviews the data on heterogeneity in solid tumors and considers the implications of these data for curative NCT.

46236 Status report on the development of a spallation neutron source for neutron capture therapy (NCT). Conde, H. (Uppsala Univ. (Sweden)); Grusell, E.; Larsson, B.; Ramstrom, E.; Ronnqvist, T.; Sornsuntisook, H.; Villa, S.; Crawford, J.; Reist, H.; Dahl, B.; Sjostrand, N.G.; Russel, G. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

The aim of the present study is to construct an accelerator-based intermediate-energy neutron source that would permit irradiation of neoplasms in the central nervous system by an intermediate-energy fluence rate of at least 10^9 n $\times$ cm^{-2} $\times$ s^{-1} in fields of 4-8 cm in diameter. The accelerator should be of a moderate size to permit accommodation in a hospital environment. In the first instance, a prototype source has to be designed that could be conveniently tested in a laboratory dedicated to radiation research, where the measurements here reported were performed. A tentative strategy is to accept a dose fraction due to neutrons above the energy range usually considered for intermediate-energy neutron therapy. Fast neutron therapy is an accepted therapeutic modality. The practical consequence of such a strategy would be that filtration of the moderated neutron beam would not be required. The work on the project has so far been devoted to studies of different moderator materials and configurations in combination with neutron production by 72 MeV protons stopped in heavy materials. The aim has been to optimize the performance of a neutron source for NCT. The required characteristics are firstly that the bulk of the neutrons should have an energy between 1-100 keV and secondly that the dose of the moderated beam should be of the order of 10^{13} $\times$n/cm^2 delivered in a time of approximately 3 hours.

46237 Uptake of boron into human gliomas of athymic mice and into syngeneic cerebral gliomas of rats after intracarotid infusion of sulfhydryl boranes. Joel, D.D.; Slatkin, D.N.; Micca, P.L.; Nawrocky, M.M.; Dubois, T.; Velez, C. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Effective boron neutron capture therapy (BNCT) of brain tumor will be dependent upon the use of boron-transport agents that give adequate levels of ^{10}B in tumor tissue but low boron concentrations in blood and normal brain. Several ^{10}B-transport agents are being studied in animals, however, only the sulfhydryl borane monomer ($Na_2B_{12}H_{11}SH$) is current used (in Japan) for the treatment of human malignant gliomas. Their studies show that after the administration of the sulfhydryl borane dimer ($Na_4B_{24}H_{22}S_2$) tumor boron concentrations are significantly higher than those obtained following the administration of equal amounts of boron as monomer. This report presents preliminary results on: (a) the uptake of monomer and dimer in tumors arising from a human malignant glioma-derived cell line inoculated subcutaneously in athymic (nude) mice; and (b) the comparison of intracarotid and intravenous infusion of monomer and dimer on the resultant boron concentrations in cerebral gliomas of rats.

46238 Toxicities of $Na_2B_{12}H_{11}SH$ and $Na_4B_{24}H_{22}S_2$ in mice. Marshall, P.G. (Memorial Hospital, Pawtucket, RI (USA)); Miller, M.E.; Grand, S.; Micca, P.L.; Slatkin, D.N. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.;

Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

The sodium salt of the anionic icosahedral borane ($B_{12}H_{11}SH^{2-}$) is used clinically in Japan, as a ^{10}B transport agent for boron neutron capture therapy (BNCT) of brain tumors. Although the dimer of that borane has greater affinity to a transplanted murine melanoma and to a transplanted rat glioma than does the parent monomer, the toxicity of the dimer has been cited as a factor that might limit its usefulness for BNCT clinically. Thus, it was considered appropriate to assess the relative severity of the toxic effects of the monomer and the dimer in mice.

46239 (IABG-B-SZ–1506/01) **Efficiency analysis of MR-imaging (investigations accompanying clinical tests) - work carried out so far. Interim report.** Ostheimer, E.; Feucht, H. Industrieanlagen-Betriebsgesellschaft m.b.H., Ottobrunn (Germany, F.R.). Haputabteilung Zentrale Studinen; Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt e.V., Koeln (Germany, F.R.); Bundesministerium fuer Forschung und Technologie, Bonn (Germany, F.R.). 1987. 105p. (In German). Contract BMFT 01VF164;IABG 263 7138 00. Available from Copy held by UB/TIB Hannover.

At first the study tasks are presented. Then the work carried out so far is described. Thereby it is shown, how fundamental considerations concerning health economics influenced the progress of the study. A concept of data collection in clinics is developed. A pattern of forms suited for data collection is given in the annex. Then the present state of MRI application is discussed with respect to performance, health risks, indications, operating conditions, economics, need of MR devices and planning of MR supply. The results obtained in this investigation were prepared to be extended towards a multi-center-study (which is taken into considerations by the Federal Ministry of Research and Technology). (orig.) With 51 refs., 8 tabs., 6 figs.

46240 (IAEA-TECDOC–506) **Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.** International Atomic Energy Agency, Vienna (Austria). May 1989. 239p. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

An Advisory Group Meeting devoted solely to review the atomic and molecular data needed for radiotherapy was held in Vienna from 13 to 16 June 1988. The following items as related to the atoms and molecules of human tissues were reviewed: Cross sections differential in energy loss for electrons and other charged particles. Secondary electron spectra, or differential ionization cross sections. Total cross sections for ionization and excitation. Subexcitation electrons. Cross sections for charged-particle collisions in condensed matter. Stopping power for low-energy electrons and ions. Initial yields of atomic and molecular ions and their excited states and electron degradation spectra. Rapid conversion of these initial ions and their excited states through thermal collisions with other atoms and molecules. Track-structure quantities. Other relevant data. Refs, figs and tabs.

46241 (IAEA-TECDOC–506, pp. 51-72) **Need for improving the accuracy in dose delivery in radio- and neutron therapy: Importance of atomic and molecular data.** Wambersie, A (Louvain Univ., Brussels (Belgium). Cliniques Universitaires St. Luc); Dam, J. van; Hanks, G.; Mijnheer, B.J.; Battermann, J.J. International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

In photon therapy, an accuracy of 3.5% in absorbed dose delivery to the dose specification point is required. It corresponds to one relative standard deviation, combining types A and B uncertainties (i.e. random and systematic, respectively). This requirment results from the steepness and the separation of the dose-response curves observed for tumour control and normal tissue complications. For both types of effects, the available clinical data are reviewed. Besides the accuracy requirement in dose level, the problem of dose distribution (or "geometry problem") is considered, and the possible consequences of an inaccuracy in patient/beam positioning are discussed. Examples taken from the "Patterns of care study" are presented, i.e. for prostatic adenocarcinoma and Hodgkin's disease. In fast neutron therapy, the required accuracy is at least as high as that required with photons. As a matter of fact, the same steepness of the dose-response curves is observed for tumour control and normal tissue complications. In addition, the physical selectivity is more critical with neutrons since a general reduction of the differential effect between cell populations has been observed after high-LET compared to low-LET radiation. The rationale for using protons and other heavy charged particles is presented. Additional basic physical data are needed for improving the accuracy in dose level as well as in physical selectivity, especially for neutrons and heavy charged particles. They are needed in order to evaluate more accurately the kerma and absorbed dose in different human and biological tissues, to determine the response of different detectors, and also to optimize the beam collimation systems and thus improve the physical selectivity of the irradiation. (author). 39 refs, 7 figs, 18 tabs.

46242 (IAEA-TECDOC–506, pp. 72-79) **Parameters characterizing charged particle track structures.** Paretzke, H.G. (Gesellschaft fuer Strahlen- und Umweltforschung m.b.H. Muenchen, Neuherberg (Germany, F.R.). Inst. fuer Strahlenschutz). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

It is well-known in radiation research that a profound knowledge of the spatial distribution of localized new chemical species produced in matter upon radiation interaction, i.e. the track structure, represents an indispensable prerequisite for the understanding of physical, chemical and biological actions of ionizing radiation. This can easily be shown by the fact that the same dose absorbed from different radiation fields can have different types and/or magnitudes of effects. Charged particle track structures evidently are characterized by joint probability functions describing the locations and types of new species at a given time; they thus represent the initial boundary condition for all subsequent reactions in the affected sector of the irradiated matter and describe it fully at later stages. However, such full descriptions are too complicated in a mathematical sense and, thus, coarser classification quantities have been searched for and introduced. Although major scientific activities are required to improve our knowledge on (a) processes of energy transfer from radiation to matter; (b) chemical modifications of target molecules by the absorbed energy; (c) non-homogeneous biochemical reactions in particle track at early times; (d) identification of parameters characterizing track structures regarding their similarities and dissimilarities with respect to the subsequent reactions, this paper discusses only the specific research needs to improve the scarce present knowledge on parameters characterizing charged particle track structures in matter. (author). 15 refs, 11 figs.

46243 (IAEA-TECDOC–506, pp. 91-105) **Atomic data required in accurate measurements of kerma for neutrons with low pressure proportional counters.** Pihet, P. (Universitaet des Saarlandes, Homburg/Saar (Germany, F.R.). Fachrichtung Biophysik und Physikalische Grundlagen der Medizin); Menzel, H.G. International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The accuracy achievable in neutron dosimetry for radiation therapy critically depends on the knowledge of the kerma factors for the tissue components and the detector materials. Gas filled cavity

chambers allow to achieve relatively accurate measurements of kerma for the chamber wall material. Ionisation chambers and proportional counters measure with high precision the charge from ionisation produced in the gas by the charged particles released in neutron interactions with the wall and with the gas. However, the overall uncertainty of the kerma measurement depends on the quality of the basic physical data required in the application of the cavity chamber principles, in particular, W-values, stopping powers and stopping power ratios for the charged particles released and their energy dependence. The paper summarizes the experience gained in evaluating atomic data to be used in cavity chamber principles for neutron kerma measurements with tissue-equivalent and non hydrogenous proportional counters. Proportional counters with walls made of A-150 TE plastic, graphite, Al, Mg, Fe, Zr and ZrO have been used to measure neutron kerma factors by several groups. Different mixtures such as methane based TE gas, propane based TE gas or CO_2 were used as counting gases. It is shown that the spectral information provided by the proportional counters can be used to assess quantities such as the gas-to-wall absorbed dose conversion factor. An attempt is made to assess the uncertainties in kerma measurements due to the uncertainties of basic atomic data. (author). 40 refs, 12 figs, 5 tabs.

46244 (IAEA-TECDOC–506, pp. 105-116) **Energy deposition in the nanometer sites based on the track structure calculations.** Olko, P. (Kernforschungsanlage Juelich G.m.b.H. (Germany, F.R.). Inst. fuer Medizin); Booz, J.; Paretzke, H.G.; Wilson, W.E. International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

In this paper microdosimetric and radial dose distributions, calculated with track structure codes Moca-8 and Moca-14 for different radiation types are presented and compared with existing experimental data. The energy deposition and ionization spectra for low site diameters are shown and the conversion factors between energy deposition and ionization are given. The influence of atomic and molecular data used by the codes on the results is briefly discussed. (author). 30 refs, 8 figs, 2 tabs.

46245 (IAEA-TECDOC–506, pp. 117-127) **Interpretation of radiobiological experiments performed with heavy charged particles.** Kraft, G. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

In heavy ion experiments, a large body of radiobiological data, (cross sections for cell inactivation and mutation, induction of both chromosome aberrations, and of strand breaks of DNA) has been measured for different atomic numbers, from helium (Z=2) to uranium (Z=92), and at energies between 1 and 1000 MeV/u which covers an LET range from 10 to 16,000 keV/μm. These data exhibit a common feature: At LET values below 100 keV/μm all data points of one specific effect form one single curve as a function of LET, independent of the atomic number of the ion. In this LET range, the biological effects are independent from the particle energy or track structure and depend only on the energy transfer. Therefore, LET is a good parameter in this regime. For LET values greater than 100 keV/μm, the curves for the different ions separate from the common curve in order of increasing atomic numbers. In this regime LET is no longer a good parameter and the physical parameters of the formation of particle tracks are important. The similarity of the σ-LET curves for different endpoints shows that the 'hook-structure' is produced by physical and chemical effects which occur before the biologically relevant lesions are formed. For this part of the reaction chain only a very limited amount of data is available. This is especially true for the emission of delta electrons. There, the energy and angular distribution of the electrons in a solid target has to be measured. Data on the interaction of the electrons and the positive deficiencies are required. The energy dependence of the production of chemical lesions should be known as well as their recombination probabilities. (author). 30 refs, 13 figs, 2 tabs.

46246 (IAEA-TECDOC–506, pp. 131-136) **Ionization yield for low energy photons and electrons absorbed in tissue-equivalent gas mixtures.** Srdoc, D. (Institut Rudjer Boskovic, Zagreb (Yugoslavia)). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

The mean energy required to form an ion pair (W) was measured for photons having energy 0.277, 1.49 and 5.89 keV in two tissue-equivalent gas mixtures. Methane- and propane-based tissue-equivalent gases are essential in measurements of radiation energy deposition in small spheres simulating human cells. The dose distribution curves on the cell-size levels (0.1 - 10 μm sphere diameter) are indispensable in human radiotherapy, especially when neutrons and heavy particles are applied. The end effects and products of any kind of absorbed radiation in tissue are broken chemical bonds and free radicals, preceeded by low energy particles, e.g. slowed down electrons. Therefore, the knowledge of the average energy required to form an ion pair at very low particle energy is very important in the so called "bookkeeping" method of studying the particle energy degradation process. The W value for low-energy electrons was calculated from experimental photon W values. An increase of W values with decreasing energy is observed in accordance with the same trend, as presented in the ICRU Report No. 31. Good agreement between the calculated and the experimental W values is obtained in low-energy region, as well as for high energy W values. Our results fill the gap between the very low energy region (below 300 eV) and the high energy (above 10 keV) region. In addition to measuring the average W-values, the results obtained by our experimental method threw light on the statistical fluctuations in the ionization yield for low energy photons. It was found that the primary distribution of ion pairs in investigated gas mixtures is asymmetrical and more peaked than the Gaussian distribution for low energy incident photons, approaching the Gaussian shape for 6 keV photons. (author). 14 refs, 3 figs, 3 tabs.

46247 (IAEA-TECDOC–506, pp. 136-150) **Experimentally determined W values, stopping powers and ranges of low-energy protons and electrons in gases: Methods and problems.** Waibel, E. (Physikalisch-Technische Bundesanstalt, Braunschweig (Germany, F.R.)). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

W values, stopping powers and ranges are fundamental atomic quantities in dosimetry, depending on the type of radiation, stopping material and energy. The information available on the average energy to produce an ion pair (W value) for protons and electrons in gases of interest is reviewed, particularly for proton energies above 1 keV and electron energies above about 20 eV. Emphasis is laid on experimentally determined stopping powers and ranges of protons and electrons in gases for that region of low energies where theoretical calculations are quite complex, giving higher uncertainties. Very few experimental data exist for energies below the stopping power maximum. To enable an adequate evaluation of spreading data resulting in recommended values, a careful analysis of uncertainties is needed. In some cases discrepancies far exceed the uncertainties quoted, and it may be supposed that the systematic deviations, depending on the method, are either not well known or not taken into account. The experimental methods are therefore discussed with respect to possible systematic uncertainties. (author). 72 refs, 14 figs.

46248 (IAEA-TECDOC–506, pp. 151-160) **Proton stopping in some oxygen compounds at intermediate energies: influences of chemical and physical state.** Bauer, P. (Johannes Kepler Univ., Linz (Austria). Inst. fuer Experimentalphysik); Mitterschiffthaler, C.; Paul, H.; Mertens, P. International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

For the therapeutical use of fast proton beams, a precise knowledge of the stopping power of pure elements and chemical compounds for protons is necessary, especially at the stopping power maximum. This maximum is found at a projectile velocity $v_1=(1.5\text{-}2.5)v_0$, depending on the velocity distribution of the slowest target electrons (Here, v_0 is Bohr's velocity). Unfortunately, the scatter of published stopping power data increases drastically with decreasing projectile energy: at and below the maximum, experimental errors are typically ~20%. In the course of the experimental cooperation between Berlin and Linz, we obtained precise stopping power data (accuracy +- 3%) for C,A1,Si,Ni,Cu,Ge,Ag and Au, for proton energies between 30 and 500 keV $(1.1\text{-}4.5)v_0$. For proton stopping cross sections in chemical compounds, deviations from simple additivity (i.e. from Bragg's rule) are expected where the valence electrons dominate the stopping process, i.e. at and below the stopping power maximum. Indeed, our measurements on $A1_2O_3$ and SiO_2 show deviations from Bragg's rule of 35% and 20%, resp., at $v=0.9\ v_0$, the stopping cross sections of the molecules being smaller than the added stopping cross sections of the constituents. This is in qualitative agreement with the fact that the valence electrons are bound more strongly in the molecule than in the atoms or gas molecules. The ratio of the stopping cross sections $\epsilon_{A1203}/\epsilon_{SI02}$ equals the ratio of the number of valence electrons (1.5) within ~2% in the proton energy range from 20 keV to 300 keV ($0.9\ v_0$ to $3.5\ v_0$), where contributions from core electrons are small. This leads to the interpretation that the valence electrons dominate the stopping process in the same way in both molecules. (Abstract Truncated)

46249 (IAEA-TECDOC–506, pp. 160-168) **Atomic and molecular processes of energy loss by energetic charged particles.** Toburen, L.H. (Battelle Pacific Northwest Lab., Richland, WA (USA)). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Understanding the biological consequences of energy loss by charged particles, whether they are high energy therapeutic ion beams or ion recoils produced by neutron interactions in tissue, requires access to a wide range of atomic and molecular data. The relative biological effectiveness of different high LET radiations, as well as a detailed understanding of the chemical and biological damage initiated, depends on the spatial pattern and form of the energy deposited within the stopping media. For fast charged particles the primary means of energy deposition is ionization of the media with the spatial pattern determined by subsequent energy transport by secondary electrons. To provide detailed descriptions of the spatial pattern of energy deposition and energy transport along charged particle tracks requires a comprehensive knowledge of the cross sections for (1) the production of electrons, as a function of ejected electron energy and emission angle; (2) electron capture and loss by the moving ion; (3) the relative probability of multiple ionization processes, i.e., simultaneous production of two or more secondary electrons; (4) the interactions of secondary electrons with the constituents of the media; (5) for dissociative ionization/excitation of the molecular constituents of the media; and (6) the subsequent ion-molecule and excited state molecular energy transfer reactions within the stopping medium. This presentation will briefly review the status of our knowledge of differential and total ionization cross sections, discuss the availability of charged particle cross sections of interest in Radiological Physics, and describe some of the areas where data is urgently needed. 45 refs, 6 figs.

46250 (IAEA-TECDOC–506, pp. 169-179) **Electron collision cross-section measurements and data for gas phase molecules (atoms) of interest to radiotherapy.** Trajmar, S. (California Inst. of Tech., Pasadena, CA (USA). JET Propulsion Lab.). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Detailed analysis and understanding of the early stages of radiation interaction with matter require the knowledge of pertinent electron-molecule collision cross sections. In spite of half a century of activities in this field and a recent increase in demands and efforts to generate cross section data, our knowledge still can be characterized only as fragmentary. In this paper the status of electron-molecule (atom) collision cross section data of interest to radiotherapy is briefly summarized in the low and intermediate-energy regions (about threshold to hundred eV impact energies). The emphasis is on data obtained from measurements carried out under single-collision conditions and associated with elastic scattering, momentum transfer, excitation (rotational, vibrational, electronic), and dissociation into neutral and charged fragments. Differential, integral and total electron collision cross section measurements and theoretical results are discussed and a projection of trends and expectations for the near future is attempted. The recent developments both in experimental and theoretical methods are very encouraging. The optimum approach to the generation of the very large body of data required is a joint experimental-theoretical effort. (Theoretical methods are not yet completely reliable and need experimental verifications. On the other hand, experimental determination of a detailed and complete set of cross sections is a difficult and tedious job; it is overwhelming in general and practically impossible in some cases.) (author). 63 refs, 5 figs, 1 tab.

46251 (IAEA-TECDOC–506, pp. 179-193) **Total and partial electron impact ionization and attachment cross-sections of atoms, molecules and clusters (quasi-liquids): A review of experimental and theoretical methods and data for radiotherapy.** Maerk, T.D. (Innsbruck Univ. (Austria). Inst. fuer Ionenphysik). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Today's knowledge of accurate absolute ionization cross sections pertaining to radiotherapy originate mostly from rather recent studies. This review first summarizes recent developments of the principal experimental, semiclassical and semiempirical methods used for the absolute ionization cross section determinations. Moreover, a critical review will be given of the available experimental data for radiotherapy (partial and total electron impact ionization cross section functions). Finally, this review is particularly dedicated to the discussion of recent studies of the inelastic interaction of slow and fast electrons in quasiliquids and/or in quasisolids (i.e. electron attachment to and electron ionization in van der Waals clusters consisting of rare gases, N_2, O_2, H_2O, etc.). (author). 139 refs, 12 figs.

46252 (IAEA-TECDOC–506, pp. 193-199) **Electron collision cross-sections for atoms and molecules determined from beam and swarm data.** Hayashi, M. (Nagoya Inst. of Tech. (Japan)). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

This paper deals with the electron collision cross-sections for H_2O molecule needed as input for electron transport calculations and for the modeling of radiation effects in biological materials. Recently, some new beam data have been published for H_2O. With these

data we have improved the cross-section values. We have discussed the values of total ionization cross-sections, and it is concluded that the recent measured values of Orient et al are too large. (author). 28 refs, 5 figs, 3 tabs.

46253 (IAEA-TECDOC–506, pp. 200-214) **Fundamental processes in radiolysis - Collision dynamics data on some elementary processes.** Hatano, Y. (Tokyo Inst. of Tech. (Japan). Dept. of Chemistry). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

A brief survey is given of recent progress in understanding fundamental processes in radiolysis with special emphasis on the present status of the knowledge of their cross section data and its implications to that of the condensed phase. Topics are chosen from our recent investigations of some elementary processes: (1) "Energy deposit" on molecular compounds: absolute VUV-photoabsorption and photoionization cross sections, (2) Dissociation of superexcited molecules, (3) Penning ionization and its related processes, and (4) Electron attachment processes. (author). 71 refs, 8 figs, 3 tabs.

46254 (IAEA-TECDOC–506, pp. 214-218) **Charge transfer involving doubly charged ions: Low energy scattering experiments as a source of state-to-state relative cross-section data.** Herman, Z. (Ceskoslovenska Akademie Ved, Prague (Czechoslovakia). Ustav Fyzikalni Chemie a Elektrochemie J. Heyrovskeho); Vancura, J. International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

Single-charge transfer processes of doubly charged atomic and molecular ions are important elementary processes in ionized media. Their state-selective cross sections are in agreement with the "reaction window" concept. The possibility of obtaining state-to-state relative cross sections of these processes in the eV and sub-eV collision energy region from scattering experiments is discussed. (author). 20 refs, 4 figs.

46255 (IAEA-TECDOC–506, pp. 218-232) **Cross-sections for 0.025 eV-1 keV electrons and 10 eV-1 keV photons.** Terrissol, M. (Toulouse-3 Univ., 31 (France). Centre de Physique Atomique); Bordage, M.C.; Caudrelier, V.; Segur, P. International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

We present total and differential cross-section for ionization and excitation of every atomic or molecular energy level, following electron or photon impact on gases relevant for radiotherapy studies such as H, N, O, He, Ar, H_2, N_2, O_2, CO_2, CH_4 or H_2O. For photons, we present here a method to obtain photoionization cross-sections for molecules. For electron after a review on all interaction processes, we show total, differential or momentum transfer cross-sections for elastic scattering and selected molecules. The methods used to obtain or derive from experimental data these cross-sections are quickly presented or discussed as well as all bibliographic references. (author). Refs, 11 figs, 6 tabs.

46256 (IAEA-TECDOC–506, pp. 235-238) **Atomic and molecular data activities for fusion in the IAEA Nuclear Data Section.** Smith, J.J. (International Atomic Energy Agency, Vienna (Austria). Atomic and Molecular Data Unit). International Atomic Energy Agency, Vienna (Austria). May 1989. (CONF-8806231–: International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy, 13-16 Jun 1988). In *Atomic and molecular data for radiotherapy. Proceedings of an advisory group meeting held in Vienna, 13-16 June 1988.* Order Number DE89635361/JAW. Available from NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS.

This paper provides some brief background information on the efforts devoted to the generation, compilation and evaluation of atomic and molecular data which are required for an understanding and interpretation of fusion plasmas. In particular, the role of the atomic and molecular data center network in the international coordination of activities will be emphasised. A summary of the data needs for fusion is given and recent references which define the current extent of the atomic and molecular data base are provided. (author). 23 refs.

46257 (INIS-SU–110/A, pp. 62-68) **Radionuclide diagnosis of metastatic skeleton tumors according to the examination of 2000 patients.** Zubovskij, G.A.; Smirnov, Yu.N. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The efficiency of scintiscanning examinations in diagnosis of skeleton metastatic injuries is determined. During scintiscanning it is possible to differentiate metastases from benign changes and to assess the activity of the pathological process. At the present development of scintiscanning it is impossible to determine nosological belonging of focal skeletal injuries. 7 refs.; 2 tabs.

46258 (INIS-SU–110/A, pp. 48-54) **Differential diagnosis of pathological processes in bram.** Lyass, F.M.; Shcherbakova, E.Ya.; Kotel'nikova, T.M. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Feasibilities of brain radioisotope γ-topography in development of differential diagnostic features of brain pathological processes were verified. A quantitative assessment of such parameters as relative buildup index, precise contour, biological characteristic was carried out. Tumoral location differ from nontumoral center by the quantitative characteristics. Comparison of quantitative criteria with anatomic topographic characteristic of the tumor center its shape and sizes considerably increase the reliability of diagnosis. 2 refs.; 1 tab.

46259 (INIS-SU–110/A, pp. 55-61) **Data of radionuclide cysternography for assessment of brain liquor system pathology.** Shcherbakova, E.Ya.; Lyass, F.M.; Sedov, V.V.; Soboleva, O.I.; Vorob'eva, E.N.; Prokof'eva, I.Sh.; Kotel'nikova, T.M. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

It is shown that radioisotope cysternography reveal pathological changes in brain liquor system, featuring its morphological and functional disturbances. Variability of radiological features directly depends on nosological form of the disease and doesn't depend of radiopharmaceutical type. 2 refs.; 1 tab.

46260 (INIS-SU–110/A, pp. 69-73) **Radionuclide diagnosis of bone system injuries in children.** Godin, V.P.; Aplevich, N.N. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Pecularities of polypositional skeleton scintiscanning with ^{99m}Tc-tin pyrophosphate in revealing primary bone system injuries in children were studied. In complex examination of children with primary and metastatic skeletal injuries performance of radioisotope examination is recommended as initial test to reveal pathological changes. The revealed suspicious centers must examined using roentgenological methods. Differences in localization pecularities of primary and metastatic skeletal injuries can not restrain from bone system scintiscanning. 5 refs.

46261 (INIS-SU–110/A, pp. 74-83) **Osteoscintigraphy in clinical practice.** Mechev, D.S. Institut Biofiziki, Moscow (USSR). 1988.

(In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Advantages and short comings of 2 osteotropic compounds ^{85}Sr and ^{99m}Te -pyrophosphate are given. Despite unsatisfactory physical parameters ^{85}Sr remains to be the only available really osteotropic compound. The necessity of searching new osteotropic preparations able to substitute ^{85}Sr is underlined. In all doubtful cases. It is recommended to initiate the examination using ^{85}Sr (as an aid in differential diagnosis) and then use ^{99m}Te-pyrophosphate (to get information of the degree of local and general dissemination of the process, to make dynamic observation, to control the degree of surgery efficiency). 1 tab.

46262 (INIS-SU–110/A, pp. 84-93) **Experience of positive scintigraphy of neoplasms of various localization.** Shishkina, V.V.; Mechev, D.S.; Tratsevskij, V.V.; Sinyuta, B.F.; Zamyatin, S.S.; Atamanyuk, N.P. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The acceptibility of radiopharmaceuticals is considered and indications for their usage to diagnose neoplasms of various localization are determined. Comparative experimental data on sensitivity, specific features and diagnostic information value of a number of tumorotropic radiopharmaceuticals in tumours of various localization are given. It shown that obvious stabilizaton of information value index of positive scintigraphy to be 80-85 %. 1 tab.

46263 (INIS-SU–110/A, pp. 94-102) **Combined radionuclide examinations in diagnosis of lung carcinoma.** Zajtseva, T.I.; Bogdasarov, Yu.B.; Afrikyan, M.N.; Karimova, L.Sh. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

It is shown that combined roentgeno-radioisotopic examination increases efficiency of differential diagnosis of malignant and benign tumors in the lungs. A feasibility of application of in vivo and in vitro examinations to control the state of patients as before operation and after surgical treatment in order to reveal recurrences and metastases is shown. 8 refs.; 2 tabs.

46264 (INIS-SU–110/A, pp. 103-107) **Positive scintigraphy with ^{67}Ga- and ^{111}In-bleomycin in diagnosis of neoplasms of peritoneal and retroperitoneal space.** Bogdasarov, Yu.B.; Zajtseva, T.I.; Prorokov, V.V.; Labunets, I.N. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

It is shown that positive scintigraphy may give additional data in doubtful case in diagnosis of neoplasms of small and large intestine. Application of scintigraphy to reveal metastases in upper abdominal and retroperitoneal lymph nodes is presented to be of special impertance, for such metastases can be hardly diagnosed by present non-isotopic methods. 9 refs.

46265 (INIS-SU–110/A, pp. 114-120) **^{111}In-citrine in clinical oncology.** Tarasenko, Yu.I.; Korsunskij, V.N.; Naumenko, A.Z.; Kosheleva, I.Yu. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Experimental studies of ^{111}In-citrine pharmokinetics showed satisfactory conditions for tumor imaging and gave substantiation for optimal methodical determination. Application of ^{111}In-citrine in 35 patients showed it's tropism to malignant tumors of various localization and histological structure. ^{111}In-citrine is of extreme value in diagnosis of tumors in the zone above diaphragm and in maxillofacial zone. ^{113}In-citrine enables to image not only primary tumors but also metastatic process and to reveal symptoms of tumoral growth and recurrences of the disease. 7 refs.

46266 (INIS-SU–110/A, pp. 121-127) **Complex in vivo - in vitro examination in case of mammary gland neoplasm.** Korsunskij, V.N.; Lapshin, V.P.; Naumenko, A.Z.; Kolpakov, I.S.; Borisov, E.A.; Tarasenko, Yu.I.; Gonina, L.I. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The results of scintiscanning of skeleton and data obtained by radioimmunoassay in patients with mammary gland neoplasms were compared. The experiments showed expediency of complex examinations in vivo and in vitro to reveal the dissemination in case of mammary gland tumours. Increase of concentration of parathyrine, prolaction, carcinoembryonic antigen in case of scintiscanning reveoding of intraosseous pathology. Not confirmed by roentgenological examinations can promote early diagnosis and differential diagnosis in metastatic skeleton injury and considerably correct treatment in such patients. 6 refs.; 1 tab.

46267 (INIS-SU–110/A, pp. 128-137) **Polyradionuclide diagnosis of lung neoplasm.** Fadeev, N.P.; Barchuk, A.S.; Keller, Yu.M. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

A clinical assessment of complex radioisotope examination of lungs in patients with suspicion of bronchogenic-neoplasm was developed. Application of various scintigraphic methods and their complexes was recommended to define precisely the character of revealed roentgenological pathological shadows of doubtful genesis in the lungs, to determine a degree of local dissemination of lung tumor on the vessels lymph nodes; to reveal lung cancer recurrences, to assess the efficiency of radio- and chemotherapy. 7 refs.; 2 tabs.

46268 (INIS-SU–110/A, pp. 138-142) **^{131}I-cholesterol scintigraphy in diagnosis of lung metastases into adrenal glands.** Zubov, G.S.; Keller, Yu.M.; Matytsin, A.N. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

A comparative study of scintiscanning of adrenal glands using ^{131}I-cholesterol and suprarenomography in diagnosis of metastatic adrenal injury in case of lung cancer was performed. It is shown that scintigraphy using ^{131}I-cholesterol is a method permitting to choose effectively patients for final stage of diagnosis of delayed metastases in case of lung cancer. According to priliminary experience indication to suprarenoscintiscanning using ^{131}I-cholesterol is considerable local dissemination of bronchogenic cancer. 6 refs.; 1 tab.

46269 (INIS-SU–110/A, pp. 143-155) **Radionuclide diagnosis of occult metastases of mammary gland tumours.** Fadeev, N.P.; Dymarskij, L.Yu.; Bat'ko, V.P.; Chebykin, I.A. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Information value of scintiscanning in revealing of latent metastatic skeleton and liver injuries in patients with mammary gland cancer was studied. Concrete indications for purposeful and effective application of the methods at different stages of examination and treatment of these patients were developed. It is shown that scintiscanning as the most sensitive method in revealing latent metastases of mammary gland cancer can be used as a criterion in application of complex of clinical laboratory, ultrasonic, computerized tomographic and radioisotopic methods in examination of liver. 9 refs.; 5 tabs.

46270 (IPEN-PUB–234) **Production and radioiodination of monoclonal antibodies and its applications in nuclear medicine.** Toledo e Souza, I.T. de; Okada, H. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Dec 1988. 21p. (In Portuguese). Order Number DE89636401/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The basis of the monoclonal antibody production methodology, some immunological concepts which are important for the understanding of what is a Monoclonal Antibody, its radioiodination and acceptance as receptor-specific radiopharmaceuticals in nuclear medicine are reviewed. (author).

46271 (IPEN-PUB–250) **Status and possibilities for biomedical applications at the Instituto de Pesquisas Energeticas e Nucleares/Sao Paulo-Brazil.** Mastro, N.L. del. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Feb 1989. 28p. (In Spanish). Order Number DE89636376/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Radiation applications in the area of biological sciences at our institution aim in the first place at the preservation and improvement of health through the development of research directed to diagnosis and therapeutics. The multiple aspects of biotechnology turn possible also classical and new applications of great importance for the community. The biomedical radiation applications performed particularly at the IPEN are summarized. (author).

46272 **In-vivo method for determining and imaging temperature of an object/subject from diffusion coefficients obtained by nuclear magnetic resonance.** LeBihan, D.; DeLannoy, J.; Levin, R.L. To Department of Health and Human Services, Washington, DC. USA Patent 7-234,101. 19 Aug 1988. 36p. Available from NTIS, PC A03/MF A01.

This Government-owned invention available for U.S. licensing and, possibly, for foreign licensing. Copy of application available NTIS.

A method of determining and imaging the temperature or the temperature change of an object (human, animal, liquid, or solid) by nuclear magnetic resonance of molecular diffusion coefficients is presented. Because of the noninvasive, nondestructive and nonionizing properties of nuclear magnetic resonance, this invention may be employed in an object or an animal continuously.

5507 Microbiology

Refer also to citation(s) 44421, 44423

5509 Pathology

Refer also to citation(s) 46321, 46322

5520 Public Health

Refer also to citation(s) 46098, 46110, 46320, 46336

5530 Agriculture and Food Technology

Refer also to citation(s) 44916, 44993, 45015, 46122, 46212, 46271

46273 (INIS-mf–11527) **Commercial trials on irradiation preservation of onions under tropical conditions.** Khan, I.; Sattar, M.; Wahid, M.; Ahmad, A.; Jan, M. Nuclear Inst. for Food and Agriculture, Peshawar (Pakistan). Jan 1988. 4p. Order Number DE89636349/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

NIFA annual report 1987-88.

The present studies for preservation and storage of life of onion on commercial scale using gamma irradiation are being carried out. According to the survey the price of onion varies during the year. The results of the previous two years studies revealed that irradiation with 0.1 KGy and subsequent storage at ambient conditions under the shade enhanced the marketable life of bulks upto about 6 months as compare to 2 months at low temperature storage. It was observed that sprouting was relatively faster and higher in the red variety than other variety. Irradiation treatment significantly decreased weight losses in both the varieties. The higher weight loss in un-irradiated onion was primarily the result of greater rate of evaporation in the sprouted bulks as compared to unsprouted (irradiate) onions. (orig./A.B.).

46274 (INIS-mf–11528) **Radiation preservation of dry fruits and nuts.** Wahid, M.; Sattar, A.; Jan, M.; Ahmad, A.; Khan, I. Nuclear Inst. for Food and Agriculture, Peshawar (Pakistan). Jan 1988. 8p. Order Number DE89636350/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

NIFA annual report 1987-88.

Dried fruits are considered a major source of income and foreign exchange in many countries. The spoilage of dried fruits and nuts by insect infestation, colour deterioration and chemical changes during storage are the serious problems especially under humid tropical conditions. The present work was undertaken to study the effect of irradiation in combination with different modified storage environments on insect infestation as well as chemical and sensory quality indices. The affect of gamma radiation dose of 1 KGy and storage environments such as air vacuum and carbon dioxide on insect infestation of dry fruits and nuts. In the case of un-irradiated samples, insect infestation progressed throughout the storage period especially in those kept under air. The vacuum storage was found better in checking infestation followed by CO/sub/2 and air. (orig./A.B.).

56 BIOMEDICAL SCIENCES, APPLIED STUDIES

Refer also to citation(s) 46198

5601 Radiation Effects

Refer also to citation(s) 44794, 45123, 46234, 46245, 46320, 46335, 46572

46275 (AD-A–207913/5/XAB) **Measurement of the radiosensitivity of rat marrow by flow cytometry. Scientific report.** McCarthy, K.F.; Hale, M.L. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 6p. (AFRRI-SR–89-8). Available from NTIS, PC A02/MF A01.

Pub. in Pharmacology and Therapeutics, Vol. 39, 79-83(1988).

Monoclonal antibodies directed against the three major glycoproteins of rat thymocytes were found to be useful for identifying hematopoietic stem cells by flow cytometry. These antibodies and their specificities are OX-7, which recognize a determinant expressed on the Thy 1.1 membrane glycoprotein; OX-22, which recognizes the high molecular weight form of the leukocyte common antigen; and W3/13, which identifies some leukocyte sialoglycoproteins. In previous studies, (McCarthy Et al., 1985, 1987; Hale et al., 1987) it was determined that the rat hematopoietic stem cell (HSC), colony-forming unit spleen (CFU-S), and prothymocyte had the phenotype of OX-7 upper 20% positive (OX-7up20%) and OX-22. This subpopulations could be further divided into two further subpopulations, a W3/13 dim and a W3/13 positive population, each representing approximately 0.17% of the total marrow cell population. Ongoing research indicates that the HSC is W3/13 dim. The agreement between the clonogenic CFU-S and phenotypic flow cytometry assays for determining the size of the HSC compartment led the authors to attempt to measure the radiosensitivity fo the HSC by flow cytometry. The results of these experiments are compared with radiation survival curve generated using the classical CFU-S clonogenic assay for HSCs, which is generally used when estimating the protective effects of drugs against hematopoietic damage.

46276 (AD-A–207914/3/XAB) **Radioprotection by biological-response modifiers alone and in combination with WR-2721. Scientific report.** Patchen, M.L.; D'Alesandro, M.M.; Chirigos, M.A.; Weiss, J.F. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 9p. (AFRRI-SR–89-9). Available from NTIS, PC A02/MF A01.

Pub. in Pharmacology and Therapeutics, Vol. 39, 247-254(1988).

Even when used alone, glucan can function protectively and/or therapeutically in radiation-injured host. When used in this manner, 'radioprotective' potential appears to be limited to (Dose Reduction Factors) of 1.2 - 1.3. However, when used in combination with even low doses of traditional aminothiol radioprotectors such as WR-2721, glucan can additively or synergistically increase DRFs to 1.5 - 1.6. Such results suggest that not only better radioprotection but also reduced toxicity may be obtained by using low-to-modest doses of several radioprotective agents that act via different mechanisms. Furthermore, based on measurements of motor performance in mice, glucan even appears to reduce the behavioral toxicity of WR-2721. Glucan is only one of several macrophage-activating Biological Response Modifiers (BRMs) that have been demonstrated to be both hemopoietic stimulants and radioprotectors. Numerous other BRMs remain to be evaluated for these effects, and they may prove to be as good as or better than glucan as radioprotectors. As

more data accumulate, it appears that these agents (alone or in combination with other agents) are establishing their usefulness in the treatment and/or prevention of acute radiation injury.

46277 (AD-A-207915/0/XAB) **Post-irradiation glucan administration enhances the radioprotective effects of WR-2721. Scientific report.** Patchen, M.L.; MacVittie, T.J.; Jackson, W.E. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1989. 12p. (AFRRI-SR-89-10). Available from NTIS, PC A03/MF A01.

Pub. in Radiation Research, Vol. 117, 59-69(1989).

Based on murine survival studies, endogeneous hemopoietic spleen colony formation (E-CFU), and recovery of bone marrow and splenic granulocyte-macrophage colony-forming cells(GM-CFC), it was demonstrated that the postirradiation administration of glucan, an immunomodulator and hemopoietic stimulant, enhances the radioprotective effects of WR-2721. These effects appeared to depend on the sequential cell protection mediated by WR-2721 and hemopoietic repopulation mediated by glucan.

46278 (AD-A-207916/8/XAB) **Attenuation and cross-attenuation in taste-aversion learning in the rat: Studies with ionizing radiation, lithium chloride, and ethanol. Scientific report.** Rabin, B.M.; Hunt, W.A.; Lee, J. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1989. 11p. (AFRRI-SR-89-11). Available from NTIS, PC A03/MF A01.

Pub. in Pharmacology Biochemistry and Behavior, Vol. 31, 909-918(1989).

The pre-exposure paradigm was utilized to evaluate the similarity of ionizing radiation, lithium chloride, and ethanol as unconditioned stimuli for the acquisition of a conditioned taste aversion. Three unpaired pre-exposures to lithium chloride blocked the acquisition of a taste aversion when a novel sucrose solution was paired with either the injection of the same dose of lithium chloride or exposure to ionizing radiation (100 rad). Similar pretreatment with radiation blocked the acquisition of a radiation-induced aversion, but had no effect on taste aversions produced by lithium aversion, but not radiation- or lithium chloride-induced aversions. In contrast, preexposure to either radiation or lithium chloride attenuated an ethanol-induced taste aversion in intact rats, but not in rats with lesions of the area postrema. The results are discussed in terms of relationships between these three unconditioned stimuli and in terms of implications of these results for understanding the nature of the proximal unconditioned stimulus in taste aversion learning.

46279 (AD-A-207918/4/XAB) **Radioprotection by leukotrienes: Is there a receptor mechanism. Scientific report.** Walden, T.L.; Kalinich, J.F. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1988. 7p. (AFRRI-SR-89-14). Available from NTIS, PC A02/MF A01.

Pub. in Pharmacology and Therapeutics, Vol. 39, 379-384(1988).

Leukotrienes are a class of biological mediators derived from arachidonic acid through the lipoxygenase pathway. Early studies showed that lipophilic factors capable of constricting smooth muscle and inducing anaphylaxis were produced in the guinea pig in response to cobra venom. Leukotrienes have pathological roles in inflammation and anaphylaxis, act as vasoactive agents, as chemotactic factors for neutrophils, and are more potent constrictors of smooth muscle than histamine. The lipoxygenase metabolites of arachidonic acid have not been as extensively characterized in terms of their cytoprotective and radioprotective properties as have the cyclooxygenase metabolites (prostaglandins, thromboxane, and prostacyclin). Research on the radioprotective properties of leukotrienes is limited by the expense and availability of pure compounds, and very little research has been done in this area thus far. Preliminary studies are presented here with the goal of discussing the current understanding of this problem and to introduce future research directions.

46280 (AD-A-207946/5/XAB) **Low-energy x-ray irradiation for electrophysiological studies.** Schauer, D.A.; Zeman, G.H.; Pellmar, T.C. Armed Forces Radiobiology Research Inst., Bethesda, MD (USA). 1989. 11p. (AFRRI-SR-89-12). Available from NTIS, PC A03/MF A01.

Pub. in International Jnl. of Radiation Applications and Instrumentation, Part A, Vol. 40, No. 1, 7-17(1989).

High-dose-rate acute whole-body exposures have been the main focus of radiobiology research conducted at the Armed Forces Radiobiology Research Institute (AFRRI) for many years. Extensive quantitative studies have been conducted analyzing behavioral effects, radiation-induced syndromes, and combined injury phenomena. Tolliver and Pellmar initiated a study to evaluate radiation damage to brain neurophysiology. A 50-kVp molybdenum target/filter x-ray tube was installed inside a lead-shielded Faraday cage. High-dose rates of up to 1.54 Gy/min (17.4-keV weighted average photons) were used to conduct local in vitro irradiations of the hippocampal region of guinea pig brains. Electrophysiological recordings of subtle changes in neuronal activity indicate this system is suitable for this application.

46281 (AECL-9504) **Progress report - Physics and Health Sciences - Health Sciences Section 1987 January 1 - June 30.** Atomic Energy of Canada Ltd., Pinawa, MB (Canada). Whiteshell Nuclear Research Establishment; Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Aug 1987. 132p. (PR-PHS-HS-3). Order Number DE89635254/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

This report covers the third semi-annual period since the Research Company was reorganized. A highlight of the period was the first peer review of all the activities in Physics and Health Sciences by external examiners. The review was conducted in April by three separate Technical Review Committees (TRC) one for each of the three main areas: health sciences, nuclear physics and condensed matter physics. In all cases the TRCs gave strong support to our programs having a mandate to assess research programs with respect to (a) their quality and (b) their relevance to Canada. The principal programs reviewed were: DNA damage and repair mechanisms; synergistic effects of chemicals and radiation; the tritium RBE study; radiosensitivity of human bone marrow cells; radioprotective enzymes; radiation biochemistry; chemistry of oxazolinones, benzofuroxanes and cyclodextrins; myeloid leukemia in mice; tritium monitoring, and quality factors; metabolic modeling; neutron dosimetry; groundwater/contaminant modeling; sediment exchange and speciation; and atmospheric dispersion. Very considerable effort was spent on preparing a proposal for a centre of excellence in toxicology for presentation in March to the Premier's Council in the Province of Ontario. Although the proposal was not one of the 7 (out of 28) successful proposals, much useful preparatory work was done towards the establishing of a centre for health and environmental research on toxic agents.

46282 Delayed effects of neutron irradiation on central nervous system microvasculature in the rate. Goodman, J.H. (Ohio State Univ. College of Medicine, Columbus (USA)); McGregor, M.J.; Clendenon, N.R.; Gordon, W.A.; Yates, A.J.; Gahbauer, R.A.; Barth, R.F.; Fairchild, R.G. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). (CONF-8802102--: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

Pathologic examination of a series of 14 patients with malignant gliomas treated with BNCT showed well demarcated zones of radiation damage characterized by coagulation necrosis. Beam attenuation was correlated with edema, loss of parenchymal elements, demyelination, leukocytosis, and peripheral gliosis. Vascular disturbances consisted of endothelial swelling, medial and adventitial proliferation, fibrin impregnation, frequent thrombosis, and perivascular inflammation. Radiation changes appeared to be acute and delayed. The outcome of the patients in this series was not significantly different from the natural course of the disease, even though two of the patients had no residual tumor detected at the time of autopsy. The intensity of the vascular changes raised a suspicion that boron may have sequestered in vessel walls, resulting in selectively high doses of radiation to these structures, or that there may have been high blood concentrations of boron at the time of treatment. The potential limiting effects of a vascular ischemic reaction in Boron Neutron Capture Therapy (BNCT) prompted the following study to investigate the delayed response of microvascular structures in a rat model currently being used for pre-clinical investigations.

46283 The effect of ionizing radiation on the blood-brain-barrier (BBB): Considerations for the application of boron neutron capture therapy (BNCT) of brain tumors. Dorn, R.V. III (EG and G Idaho, Inc., Idaho Falls (USA)); Spickard, J.H.; Griebenow, M.L. pp. 370 of Clinical aspects of neutron capture therapy. Fairchild, R.G.; Bond, V.P.; Woodhead, A.D.; Vivirito, K. (eds.) Plenum Press, New York, NY (USA) (1988). DOE Contract AC07-76ID01570. (CONF-8802102–: Workshop on clinical aspects of Boron Neutron Capture Theory (BNCT), 1-2 Feb 1988).

All methods of boron neutron capture therapy (BNCT) in use or envisioned for treatment of brain tumors have, as an inseparable component, an element of ionizing radiation. This paper reviews data on the effects of ionizing radiation on the blood-brain-barrier (BBB) and the blood-tumor-barrier (BTB) and the potential impact of the effects on the delivery techniques of BNCT. This paper has the following objectives: review the available technique for BNCT of brain tumors; review the literature on experimental and human studies regarding the effects of ionizing radiation on the BBB; discuss the impact of these effects on the fractionization question for BNCT; and draw conclusions from that information.

46284 (CONF-8806237–) **DOE/CEC [Department of Energy/Commission of the European Communities] workshop on critical evaluation of radiobiological data to biophysical modeling.** USDOE Office of Energy Research, Washington, DC (USA). Office of Health and Environmental Research; Commission of the European Communities, Brussels (Belgium). [1988]. 47p. Sponsored by U.S. DOE Energy Research. From DOE/CEC workshop; 22-24 Jun 1988. Order Number DE89015214/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Department of Energy's Office of Health and Environmental Research and the Commission of the European Communities (CEC) Radiation Protection Program support the majority of Research in the Field of Radiobiological Modeling. This field of science develops models based on scientifically sound principles to predict biological response (at the cellular, molecular, and animal level) to exposure to low level ionizing radiation. Biophysical models are an important tool for estimating response of ionizing radiation at low doses and dose rates. Generally speaking, the biophysical models can be classified into two groups: (1) mechanistic models and (2) phenomenological models. Mechanistic models are based on some assumptions about the physical, chemical, or biological mechanisms of action in association with radiobiological data whereas the phenomenological models are based solely on available experimental data on radiobiological effects with less emphasis on mechanisms of action. There are a number of these models which are being developed. Since model builders rely on radiobiological data available in the literature either to develop mechanistic or phenomenological models, it is essential that a critical evaluation of existing radiobiological data be made and data that is generally considered good and most appropriate for biophysical modeling be identified. A Workshop jointly sponsored by the DOE and the CEC was held at Oak Ridge, Tennessee from June 23–25, 1988, to review the data available from physical and chemical, cellular and molecular and animal studies with ionizing radiation.

46285 (CONF-8904261–1) **Experimental radiobiology and radiation protection studies.** Fry, R.J.M. Oak Ridge National Lab., TN (USA). 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From National Council on Radiation Protection and Measurements (NCRP) annual meeting; 5 Apr 1989. Order Number DE89015969/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In the past the contribution of experimental animal data to the risk estimates for external radiation carcinogenesis has been limited. In the future the contribution will have to be greater if the influence of dose rate and radiation quality on radiation-induced cancer are to be assessed. It is important that accepted methods of extrapolation of risk estimates across species are developed and there appear to be some methods with promise. The study of mechanisms of radiation carcinogenesis are central to experimentalists' studies and the understanding of the mechanisms will help to formulate better models, for example, of dose-response relationships but such studies will not solve all the problems of risk estimation. 27 refs., 6 figs.

46286 (DOE/NV/10630–T2) **A curriculum model for Nevada Test Site radiation protection technician training.** Petullo, C.F. Nevada Univ., Las Vegas, NV (USA). May 1989. 72p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-89NV10630. Order Number DE89015931/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A research project was undertaken to develop a performance-based curriculum model for Nevada Test Site Radiation Protection Technicians. The study began with an overview of Radiation Protection Technician training curricula within the Department of Energy (DOE) Government Contractor system and the Training Accreditation Manuals used for program evaluation of DOE system training programs. The research design included data from a two page questionnaire. Further data were provided from other Radiation Protection Technician training programs within the DOE system. The developed model utilized a five-phase/step approach to curriculum design encompassing (1) needs analysis, (2) designing the training process, (3) development of curriculum and support materials, (4) training implementation, (5) training evaluation. The Needs Analysis determined the specific material to be covered in the training program. Designing the Training Process involved choosing, from the core/generic job tasks identified in the Needs analysis, the specific knowledge and skills learning objectives for the program. Development of Curriculum and Support Materials involved choosing the method of instruction, identifying which tasks would be taught on-the-job and designing the qualification standard and lesson plans for the tasks. 24 refs., 6 figs., 3 tabs.

46287 (EGG-BNCT–8353-Vol.3-No.3) **PBF/BNCT [Power Burst Facility/Boron Neutron Capture Therapy] program for cancer treatment: Volume 3, No. 3.** Ackermann, A.L. (ed.). EG and G Idaho, Inc., Idaho Falls, ID (USA). Mar 1989. 141p. Sponsored by U.S. DOE Energy Research. DOE Contract AC07-76ID01570. Order Number DE89016270/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Highlights of the PBF/BNCT Program during March include: gross boron analysis in tissue blood and urine; analytical methodologies development for BSH (sodium borocaptate) purity determination; boron microscopic (subcellular) analytical development; noninvasive boron quantification determination; dosimetry; and analytical radiation transport and interaction modeling for BNCT.

46288 (EGG-BNCT–8353-Vol.3-No.4) **PBF/BNCT Program for cancer treatment: Bulletin.** Dorn, R.V. III; Ackermann, A.L. (ed.). EG and G Idaho, Inc., Idaho Falls, ID (USA). Apr 1989. 49p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016269/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Highlights of the PBF/BNCT Program during March include progress within the areas of: Gross Boron Analysis in Tissue Blood and Urine, Analytical Methodologies Development for BSH (Sodium Borocaptate) Purity Determination, Boron Microscopic (Subcellular) Analytical Development, Noninvasive Boron Quantification Determination, Dosimetry, Analytical Radiation Transport and Interaction Modeling for BNCT, Large Animal Model Studies, and Neutron Source and Facility Preparation.

46289 (EGG-FSP–8552) **Accident safety comparison of elements to define low activation materials.** Piet, S.J.; Cheng, E.T.; Porter, L.J. EG and G Idaho, Inc., Idaho Falls, ID (USA). 20 Jul 1989. 209p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. Order Number DE89016210/JAW. Available from NTIS, PC A10/MF A01 - OSTI; GPO Dep.

This report quantifies what "low activation" means with regard to accident safety for naturally occurring elements from hydrogen through bismuth. The activation inventory from a neutron flux of 5 MW/m^2 for 4 years exposure at the first wall to a deuterium-tritium plasma was used for four figures of merit including: Prompt Dose Rating (PDR) based on the release fraction required to avoid any offsite acute radiation fatalities; Latent Dose Rating (LDR) based on the allowable release fraction to minimize offsite latent statistical cancers; Time Before Damage (TBD) based on the initial temperature rise rate from decay heat and the time available before damage (a 300° temperature rise); and Maximum Temperature Rise (MTR) based on the maximum temperature rise. The first two

figures of merit use the radioactive inventory and offsite dose calculations using the FUSCRAC3 computer code. The second two figures of merit are based on decay heat and simple generic blanket thermal models.

46290 (EUR–11608) **Health and safety in the nuclear age.** Commission of the European Communities, Luxembourg (Luxembourg). 1988. 267p. (CONF-8710473–: Seminar on third party financing for energy savings, 8-9 Oct 1987). Available from European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037.

In their Communication to the Council on the development of Community measures for the application of Chapter III of the Euratom Treaty - Health and safety (COM(86) 434 final) the Commission of the European Communities announced their intention to initiate a 'Standing Conference on Health and Safety in the Nuclear Age' in order to contribute to an increase of information on nuclear activities. Following this proposition, the Commission (Directorate-General for Employment, Social Affairs and Education, Health and Safety Directorate) organized the first meeting of this Standing Conference in Luxembourg on 5, 6 and 7 October 1987 with the theme 'Information for the public and the media on health protection and safety with regard to nuclear activities'. About 120 participants representing scientific experts, the media, the bodies concerned with environmental or consumer protection, the social partners and interested national and international organizations, took part in this conference. It was the first time at European Community level that a meeting allowed an exchange of positions on the health problems related to ionizing radiation by all the parties interested in this subject. The Commission was asked to pursue this dialogue in order to improve the perception of citizens of the Community of the potential risks and the methods of protection brought into force in the nuclear field.

46291 (EUR–11608, pp. 21-34) **Radiation all around us.** McAulay, I.R. (Trinity Coll., Dublin (IE)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8710489–: 1. meeting of the standing conference on health and safety in the nuclear age, 5-7 Oct 1987). In *Health and safety in the nuclear age.* Order Number DE89908200/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

Possible developments on radiation protection of the public within the European Community are evaluated. The greatest source of radiation exposure to the public arises from radon and its daughters. This exposure can be controlled and reduced by the application of special building techniques and remedial measures of the man made sources of exposure, medical radiation contributes the biggest share. Encouragement will be given to the more widespread use of techniques which can give the required information with a reduced dose. The other contributors to artificial sources of exposure are all relatively small. The dose to the public, from nuclear power and nuclear reprocessing, have been shown to be small and to be decreasing steadily. It is important, however, that continuing scientific studies be made on discharges of radioactivity to the environment and the resulting doses, both to ensure that desirable trends continue and to provide warning and information on incidents and accidents. Similar considerations should apply to other sources, such as fallout from weapons tests or the use of radioactivity in consumer goods.

46292 (EUR–11608, pp. 36-62) **Types and risks of radiation effects.** Jacobi, W. (Gesellschaft fuer Strahlen-und Umweltforschung m.b.H. Muenchen, Neuherberg (DE). Inst. fuer Strahlenschutz). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8710489–: 1. meeting of the standing conference on health and safety in the nuclear age, 5-7 Oct 1987). In *Health and safety in the nuclear age.* Order Number DE89908200/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

In this paper the action of ionizing radiation on living organisms is shortly described and the resulting effects and risks are outlined. Main emphasis is given to the epidemiological findings on radiation-induced cancer and their consequences for the estimation of risks at low doses.

46293 (EUR–11608, pp. 63-80) **Quantitative assessment of risks resulting from exposure to radiation: problems of extrapolation and the choice of indicators.** Fagnani, F. (Centre d'Etude sur l'Evaluation de la Protection dans le domaine Nucleaire, 92 - Fontenay-aux-Roses (FR)). Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8710489–: 1. meeting of the standing conference on health and safety in the nuclear age, 5-7 Oct 1987). In *Health and safety in the nuclear age.* Order Number DE89908200/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

Some of the methodological problems involved in the quantitative estimate of the health detriment of ionizing radiations and in risk comparison are described. The limitations of the process of quantifying the risks resulting from exposure to low doses of radiation are both specific and non-specific. The results obtained, which are then used at international level, provide particularly reliable reference data on which there has been a surprisingly high level of agreement. The current revision of the dosimetry of Hiroshima and Nagasaki and the publication of the results of 30 years of follow-up carried out on the cohort against the background of the Chernobyl accident must not be misunderstood. These new aspects have revived the discussion on the risks of exposure to low doses and their acceptability to the public. However, it should be noted that recent scientific data have resulted in minor changes to previous estimates. The uncertainty is far lower than for other toxic and carcinogenic risks in the environment. It is probable that this increase in scientific knowledge is responsible for the well-known discussion and has caused an example to be made of this particular risk. In terms of science and institutions, this area of prevention is in some ways a model for the treatment of industrial hazards by society in the future.

46294 (INFO–0255) **Incidence of genetic disorders in children and young adults.** Anderson, T.W.; Baird, P.A.; Lowry, R.B.; Newcombe, H.B. Atomic Energy Control Board, Ottawa, ON (Canada). Nov 1987. 119p. Order Number DE89636327/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Current estimates of the genetic risks from exposure to ionizing radiation are based on two kinds of data: (a) incidence rates in humans for the genetic diseases that are believed to be present in the population due to mutations of natural origin, and (b) radiation induced mutation rates. One necessary prerequisite before any possible increase in genetic load from mutagens can be estimated is baseline information on the magnitude of genetically-caused ill health already present in the population. The present study utilizes the data base of an ongoing population-based Registry with multiple sources of ascertainment to estimate the present population load from genetic disease. It was found that 4.9% of liveborn individuals below 25 can be expected to have genetic or partly genetic diseases. This was composed of single-gene disorders (autosomal dominant, autosomal recessive and X-linked recessive), chromosomal anomalies and multifactorial disorders (including those present at birth and those later in onset). Since previous studies have usually considered all congenital anomalies (ICD 740-759) as part of the genetic load, data are also presented separately for this category to facilitate comparison with earlier studies. These new data should represent a better estimate of the genetic load in the population than previous studies.

46295 (INIS-BR–1566) **Study of non-thermal effects from laser radiation on live tissues.** Cotta, M.A. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. Feb 1987. 97p. (In Portuguese). Order Number DE89636315/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The functional biological effects related to the irradiation of live tissues with low power lasers, called non-thermal effects were theoretical and experimentally studied. For the experimental part, a device which allows to: irradiation lesions artificially created on the back of rats by a He-Ne laser, or put a moving ground glass in front of the laser beam, by irradiation of this same laser with its coherence degree decreased. The relevance of the radiation coherence in the lesion cicatrization process was shown. The electrical field distribution and the intensity distribution on a surface with microroughness when irradiated by coherent light are theoretically studied. (M.C.K.).

46296 (INIS-BR–1607) **Effects of ionizing radiation in crotamine from Crotalus durissus terrificus venous.** Costa, T.A. da. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). 1988. 98p. (In Portuguese). Order Number DE89636302/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Ionizing radiations are sufficiently energetic and able to cleave any chemical bond. Molecules of substances present in solution have been shown either by direct or indirect action of ionizing radiations loss of biological activity. Crotamine obtained from C. d. terrificus venom by molecular exclusion cromatography was irradiated in aqueous solution of 1 mg/ml by gamma rays produced on a ^{60}Co source. Doses of 100 Gy, 2000 Gy and 5000 Gy (Dose rate = 1,14 x 10^3 Gy/h) in presence of O_2 were used for the comparison of properties of irradiated and non irradiated samples; the following assays were performed: determination of protein concentration, presence of free SH groups, SDS-Page and Ouchterlony's immunodiffusion. The Ellman's reaction for free SH groups was positive in the irradiated protein and negative one. The protein concentration was not altered up to the dose of 2000 Gy in relation to the native protein: at the dose of 5000 Gy was observed a loss of 55% of the proteic material. The SDS-PAGE analysis showed the formation of protein aggregates in the dose of 2000 Gy and 5000 Gy. A loss of the antigenic activity was observed both in the dose of 2000 Gy and 5000 Gy againt sera anticrotalic. Further studies was perfomed with crotamine irradiated at the dose of 2000 Gy in aqueous solution, O_2 absence and in presence of different concentrations of radioprotectors such as: cystein, sodium nitrate and tert-butanol. The level of the radioprotection to the toxin was estimated through the simple radical immunodiffusion technique. According to the technique the best radioprotective agent was cysteine. Since the antigenic determinants were preserved and in the SDS-PAGE analysis the crotamine structure was maintained entire like the non irradiated toxin. (author).

46297 (INIS-mf–11530) **Biochemical and microbiological quality of spices.** Sattar, A.; Mahmood, F.; Wahid, M.; Jan, M.; Khan, I. Nuclear Inst. for Food and Agriculture, Peshawar (Pakistan). Jun 1988. 5p. Order Number DE89636313/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

NIFA annual report 1987-88.

The spoilage of spices is generally due to microbial contamination as well as development of off-favours due to oxidation of oils. This research was conducted to investigate the influence of irradiation doses (2-10 KGy) on bacterial and fungal contamination as well as col colour and volatile components during storage of spices. The influence of different gamma radiation doses on total mould count of spices such as turmeric, coriander, chilies, cumin and black pepper, was determined and the results are presented. The effect of irradiation on total bacterial counts of these spices is presented. The dose of 10 KGy decreased the bacterial counts to either undetectable or very low levels in various spices. (orig./A.B.).

46298 (INIS-mf–11531) **Effect of gamma irradiation on the physicochemical and cooking characteristics of chickpea.** Aurangzeb; Ahmad, M.; Bibi, N.; Badshah, A.; Khan, I. Nuclear Inst. for Food and Agriculture, Peshawar (Pakistan). Jun 1988. 9p. Order Number DE89636314/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

NIFA annual report 1987-88.

Gamma irradiation has long been know as a method of food preservation. Radiation treatment at moderate doses has been recommended for disinfestation of legumes. The treatment is shown to the effective for reduction of flatulence causing oligosaccharides and also of trypsin and chymotrypsin inhibitors. The nutritive quality of irradiated le is also enhanced. It has also been reported that short term feeding of irradiated diets to rats did not give any indication of mutagenic effects. (orig. /A.B.).

46299 (INIS-mf–11951) **Chernobyl - what can natural scientists or physicians say to that accident?. Brief lectures.** Stadt Mainz (Germany, F.R.); Mainz Univ. (Germany, F.R.). 1986. 45p. (In German). (CONF-8606429–: Joint discussion meeting of the Johannes Gutenberg University, the Max Planck Institute, and the local government of Mainz, 13 Jun 1986). Order Number DE89910834/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The public discussion meeting was intended to offer to the general public a platform for discussion of questions evoked by the Chernobyl reactor accident, and scientific information on what has happened there. The brief lectures therefore deal with the accident scenario as far as assessable at the time, and with the consequences to be expected for the Federal Republic of Germany, with the fallout situation in the Mainz area, and the atmospheric dispersion and transfer of air masses from Chernobyl to the FRG. The medical experts presented information on the radiation exposure of the population and the possible genetic risk. (DG).

46300 (INIS-SU–110/A, pp. 6-13) **^{67}Ga and ^{111}In buildup in neoplasms depending on chemical factors.** Sorokin, V.P.; Kozlova, M.D. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

^{67}Ga and ^{111}In with carrier and without it in the complex with 18 ligands of various molarity, with different pH values and additions were studied. The compound kinetics and excretion were examined in healthy rats and rats with inoculated tumours in the area of femur. The largest buildup of ^{67}Ga-citrate was observed with citrate concentration 1.01M and pH=6.0 in the tumor. The largest buildup of ^{3}In was noted in the tumor (1% per 1g, ratio neoplasm: muscle 700:1) in case of intravenous injection of ^{3}In without carrier in combination with lactate (0.1 M with pH=2) in the presence of EDTA (0.001 M). 3 refs.; 4 tabs.

46301 (INIS-SU–110/A, pp. 14-18) **Experimental study of fats and fatty acids labelled with I-131 in lung tissue.** Fadeev, N.P. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The carried out experiments enable to state that labelled fatty acids ^{131}I-OA (oleic acid in particular) are capable to be accunulated in the lungs in quantities sufficient for imaging. Optimal period for lung scintigraphy-24h following fatty acid intake. The information value of the method can be signifacantly increased by using short-lived and extremely short-lived radioisotopes such as ^{99m}Te and ^{2}C as a radioactive label. 3 refs.

46302 (INIS-SU–110/A, pp. 19-23) **Study of diagnostic information value of ^{57}Co-bleomycitin A_5 in animals with neoplasms of various strams.** Dedenkov, A.N.; Petriev, V.M.; Prusova, R.M. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The experimental data showed that nevly obtained tumorotropic ^{57}Co-BLM A_5 has very high diagnostic information value and can be used in imaging of neoplasms. The level of the preparation buildup doesn't depend on tumor histological structure. 2 refs.

46303 (INIS-SU–110/A, pp. 24-28) **Study of melanotropic properties of ^{125}I-chloroquine in the experiment.** Fadeev, N.P.; Savel'eva, O.P.; Rumyantseva, L.N.; Bobrova, V.N. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

The carried out experiments showed that ^{125}I-chloroquine is of very high tropism in relation to melanoma tissue and the character of its kinetics in the organism of mice-tumorcarriers is quite favourable to reveal as a primary neoplasm and metastases in various lymph regions and lung, liver etc. It is advisable to use ^{131}I as a label of chloroquine for radioindication of melanoblastomas and particularly its metastases in man. 8 refs.

46304 (INIS-SU–110/A, pp. 29-36) **Proteolytic and inhibiting activity of blood of tumor-carriers.** Kulakov, V.N.; Dolgikh, M.S.; Bazhenova, T.L.; Korshunov, V.B. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection*

of scientific papers. Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

Inhibition activity of blood considerably changes in the direction of decrease of free inhibitors in man and rabbits. That fact is explained by formation of free proteinases which bind part of inhibitors in case of carcinogenesis. The obtained data testify to the change of enzymeinhibitor ratio which is violated due to apperance of tumoral source. Radioenzymatic method of blood inhibition activity determination can be used in clinical picture as a diagnostic one and to control the efficiency of treatment measures as well. 12 refs.; 2 tabs.

46305 (INIS-SU–110/A, pp. 37-47) **Feasibilities of application of proteinases labelled with iodine radioactive isotopes, of their predecessors inhibitors and substrates in assessment of tumor effect on the organisms.** Sedov, V.V.; Sorokin, V.P.; Matveev, V.A.; Korshunov, V.B.; Pimenova, G.N.; Kulakov, V.N. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

A comparative study of the behaviour of proteinases labelled with iodine of proteinase predecessors, of inhibitors in intact animals and in animals with transplanted tumors was carried out. Data on the increase of the intensity of radioactive substance excretion with urine following injection of ephatine-^{125}I to animals with tumors (by 2 fold in relation to intact animals during 1 h) and on decrease of the radioactive substance buildup in gastro-intestinal tract are obtained. These processes are connected with the change of the given high molecular compound concentration induced by tumor growht. 6 refs.; 5 tabs.

46306 (INIS-SU–110/A, pp. 156-168) **Intra-arterial injection of radioactive microspheres in neoplasm treatment.** Sedov, V.V.; Volodin, I.A.; Tronova, I.N. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

A laboratory methods to obtain microspheres with ^{90}Y was developed. In the experiment on animals a possibility of the microspheres application for intraarterial injection for radiation treatment of highly vascularized neoplasms was shown. 25 refs.

46307 (INIS-SU–110/A, pp. 169-176) **Pharmacokinetics of cesium mercaptoundehydrododecaborate compound for neutron-capture therapy.** Spryshkova, R.A.; Brattsev, V.A.; Najdenov, M.G.; Shabalkin, I.P.; Serebryakov, N.G. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

It is stated that mercaptoundercahydrododecaborate actively joins dividing cells of neoplasm and is detanied by tumoural tissue at least for 48 h. Fast removal of mercaptoundecahydrododecaborate from neighbouring to tumour tissues and its retention in tumoural tissue enale (using repeated injection of the preparation into the organism) to create required for neutron capture therapy boron concentration gradient between tumoural and neighbouring normal tissues. 4 refs.; 2 tabs.

46308 (INIS-SU–110/A, pp. 182-186) **Experimental assessment of endolymphic therapy with radiopharmaceuticals.** Slobodyanik, I.I.; Mairt'yanov, B.M. Institut Biofiziki, Moscow (USSR). 1988. (In Russian). In *Radiopharmaceuticals in oncology. Collection of scientific papers.* Order Number DE89012209/JAW. Available from NTIS (US Sales Only), PC A09/MF A01; INIS.

An assessment of endolymphatic therapy efficiency using 2 new native preparations with ^{198}Au and ^{90}Y possessing roentgenocontrast properties was carried out. It was shown that endolymphatic irradiation of Brown-Pierce neoplasm with oil solutions containg ^{198}Au, ^{90}Y considerably decreases animals mortality. More pronounced treatment effect was observed in endolympliatic therapy with ^{90}Y oil solution. 1 tab.

46309 (LBL–27448) **The health risks of radon: The BEIR IV report and beyond.** Fabrikant, J.I. Lawrence Berkeley Lab., CA (USA). Jun 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8906195–1: Radon homes: dangerous or not?, 15 Jun 1989). Order Number DE89015335/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The National Academy of Sciences' BEIR IV Report deals with the health effects in human populations exposed to internally-deposited alpha-emitting radionuclides and their decay products. Quantitative risk estimates for cancer induction are derived, mainly from analyses of epidemiological data. The Report addresses the health outcomes of exposure to radon and its daughters, primarily lung cancer risks of worker exposure to radon progeny in underground mines and in the general public in indoor domestic environments. An excess relative risk model of lung cancer mortality and exposure to radon progeny is developed; this models the excess risk per Working Level Month in terms of time intervals prior to an attained age, and is dependent on time-since-exposure and age at risk. Risk projections are presented and cover exposure situations of current public health concern. For example, the lifetime risk of lung cancer mortality due to lifetime exposure to radon progeny in terms of WLM and alpha-particle dose to the target cells of the bronchial epithelium is estimated to be 350 excess deaths per million person-WLM. Lifetime exposure to 1 WLM y_{-1} is estimated to increase the number of deaths due to lung cancer by a factor of about 1.5 over the current rate for both males and females in a population having the current prevalence of cigarette-smoking. Occupational exposure to 4 WLM y_{-1} from ages 20 y to 40 y is projected to increase lung cancer deaths by a factor of 1.6 over the current rate of this age cohort in the general population. In all of these cases, most of the increased risk occurs to smokers for who the risk is up to ten times greater than for nonsmokers. 10 refs., 1 tab.

46310 (NRPB-GS–10) **Generalised derived limits for radioisotopes of ruthenium. Guidance on standards.** Robinson, C.A.; Haywood, S.M. National Radiological Protection Board, Chilton (UK). Jan 1989. 32p. Available from H.M. Stationery Office, London, price Pound 5.00.

Generalised derived limits (GDLs) are presented for the radiologically significant isotopes of the element ruthenium, ruthenium-103 and ruthenium-106. These GDLs are derived from an annual effective dose equivalent limit of 1 mSv. The GDLs are intended for use as convenient reference levels against which the results of environmental monitoring can be compared and atmospheric discharges assessed. Generalised derived limits are calculated for uniform conditions over a year and use deliberately cautious assumptions concerning the habits and location of the critical group of exposed individuals in the population and, where appropriate, concerning the conditions of discharge and the prevailing weather conditions. If the environmental contamination over a year or discharge to the atmosphere exceeds about 25% of the GDL, critical-group doses should be examined more closely, taking account of site-specific factors and the duration of the period of excess. For ruthenium-103 the most important exposure pathway, from discharges to the atmosphere, is external irradiation from deposited activity. This pathway is also an important contributor to dose for ruthenium-106, but in this case the dominant pathway is the inhalation of activity from the cloud. (Author).

46311 (ORAU–88/F-111) **A compendium of major US radiation protection standards and guides: Legal and technical facts.** Mills, W.A.; Flack, D.S.; Arsenault, F.J.; Conti, E.F. Oak Ridge Associated Universities, Inc., TN (USA); Social, Educational Research and Development, Inc. (USA). c Jul 1988. 141p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-76OR00033. Available from Oak Ridge Associated Univ., Office of Information Services, P.O. Box 117, Oak Ridge, TN 37831-0117.

Following discussion of the general issue, the CIRRPC Executive Committee approved, with concurrence of the full Committee, an Oak Ridge Associated Universities (ORAU) staff proposal to develop a compendium of Fact Sheets on the major US radiation protection standards and guides, existing or proposed. The compendium contains relevant legal or statutory information and detailed technical requirements that state and describe the protection to be achieved. The report provides appropriate legislative citations; notes any

legislative language that gave direction to the development of standards promulgated under the legislation; cites rationales for the standards promulgated; and provides a listing of related standards. Two consultants with considerable experience in radiation protection regulations were contracted to assist the ORAU staff in developing the report. This report has been reviewed twice by the CIRRPC member agencies; once to ensure the accuracy of all the legal and technical facts in the compendium, and once to comment on the entire document, including the accompanying text. This final report reflects consideration of all the agencies' comments received during the reviews. Part I of this report presents information on the selection, preparation and content of the Fact Sheets; an overview of their scopes, applications and modes of control; and the ORAU conclusions and recommendations. Part II contains the Fact Sheets and a User's Guide to finding relevant information in the Fact Sheets.

46312 (ORNL/TM–10971, pp. 1-9) **Radiation protection in the hospital environment.** Vetter, R.J. Oak Ridge National Lab., TN (USA). Nov 1988. (CONF-881032–: 2. conference on radiation protection and dosimetry, 31 Oct - 3 nov 1988). In *Proceedings of the second conference on radiation protection and dosimetry.* Order Number DE89001663/JAW. Available from NTIS, PC A11/MF A01.

The hospital environment contains numerous sources of ionizing radiation that may contribute to public and occupational radiation exposure. Radiation exposure from x rays is minimized through engineering design, administrative controls, and quality control. Exposure from patients that contain therapeutic quantities is minimized by isolation in appropriately controlled private rooms. Administrative controls are relied on for controlling radiation exposure from diagnostic nuclear medicine patients. Hospital radiation installations must be planned and periodically reviewed to take advantage of the latest developments in radiation protection and to keep public and occupational exposure as low as reasonably achievable.

46313 (PNL–6450-21-HEDR) **Hanford Environmental Dose Reconstruction Project: Monthly report.** Dennis, B.S. (comp.). Pacific Northwest Lab., Richland, WA (USA). Jul 1989. 44p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. Order Number DE89016242/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This summary covers progress for the month of July 1989 during which we completed the scheduled milestone 0504-B, Measured River Fish Concentrations; presented a project status update at the TSP meeting on July 21 in Richland, WA; presented the potential role of iodine-129 in the HEDR Project at the TSP meeting; displayed posters at the TSP meeting summarizing available information for the Columbia River between Priest Rapids Dam and McNary Dam; held a working session on the dose calculational model with PNL staff, TSP members, and three members of the public; presented an overview of the HEDR Project's Quality Assurance (QA) program to six members of the TSP; continued internal PNL clearance on several draft reports, which will become part of the Phase I summary report; completed entry of meteorological data for 1983 through 1987 into the meteorological data base; completed verification of the modified MESOILT code; completed preliminary reviews of the analytical methods used as the basis for determining potential biases and the level of uncertainty for two milestones, 0504-B, Measured River Fish Concentrations and 0503-B, Final River and Sediment Monitoring Data; and completed the creation and verification of data files on radionuclide concentrations in vegetation through August 1946.

46314 (PNL–6500-Pt.4, pp. 33-35) **Microdosimetry of fast heavy ion beams.** Metting, N.F.; Braby, L.A.; Toburen, L.H.; Kraft, G.; Scholz, M.; Kraske, F.; Schmidt-Boecking, H.; Doerner, R.; Seip, R. Pacific Northwest Lab., Richland, WA (USA). Jun 1988. In *Pacific Northwest Laboratory Annual Report for 1987 to the DOE Office of Energy Research: Part 4, Physical Sciences.* Order Number DE88014094/JAW. Available from NTIS, PC A05/MF A01.

Biophysical and biochemical studies of the effects of high-LET radiation under way at numerous laboratories indicate the importance of understanding the pattern of energy deposition in volumes comparable to that of subcellular structures. The inadequacy of LET as a quantitative description of radiation quality has been shown in numerous experiments employing heavy charged particles. In order to better understand the molecular mechanisms responsible for the biological effects of high-LET radiation, it is important to obtain more detailed information regarding the stochastic nature of energy deposition in volumes of subcellular dimensions. During the past year we have completed a study of the distributions of ionization as a function of the radial distance from high-energy iron ions in collaboration with scientists from Lawrence Berkeley Laboratory (LBL) and Columbia University and initiated new studies at the UNILAC accelerator at GSI-Darmstadt, West Germany.

46315 (UCID–21672) **Work plan radiological assessment of the Laboratory for Energy-Related Health Research.** Layton, D.W.; Noshkin, V.E. Lawrence Livermore National Lab., CA (USA). May 1988. 21p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. Order Number DE89015616/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Laboratory for Energy Related Health Research (LEHR) is a facility owned by the US Department of Energy (DOE) and operated by the University of California (UC). The LEHR facilities are located on UC-owned lands south of the main campus of UC Davis. A number of DOE-funded laboratory studies involving different radionuclides have been conducted at LEHR since 1959. Two major projects were long-term toxicity studies with beagles administered ^{90}Sr and ^{226}Ra. In recent years DOE funded research has declined, and the DOE has decided to transfer the buildings at LEHR to UC. Property-transfer actions involving federally-owned facilities that may have residual contamination with radioactive substances must undergo a formal certification process. A key component of the certification process is a radiological survey to determine the nature and extent of any residual contamination. Areas with radioactivity above acceptable levels are decontaminated and then monitored for compliance. Normally, the decommissioning goal is to allow unrestricted uses of facilities, however, in some instances restrictions may be placed on uses if complete decontamination is infeasible or prohibitively expensive. All actions and supporting documentation regarding the transfer of contaminated facilities are contained in an official certification document. The purpose of this document is to describe the sampling and analysis protocols that will be used to carry out the radiological survey of the LEHR facilities. 5 refs., 1 fig., 1 tab.

46316 (WHC-SA–0484) **A practical method of performing cost-benefit analysis of occupational and environmental protective measures.** Boothe, G.F.; Webb, D.E. Westinghouse Hanford Co., Richland, WA (USA). Mar 1989. 12p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-87RL10930. (CONF-890935–1: International workshop on new developments in occupational dose control and ALARA implementation at nuclear power plants and similar facilities, 18-21 Sep 1989). Order Number DE89008795/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A practical method of performing cost-benefit analysis for radiation protective measures relative to specific jobs or projects has been developed. The method is applicable to protective measures for both occupational and public radiation exposures. The method provides a straightforward, consistent procedure for weighing the cost and impact of protective measures against the benefits derived. The procedure employs various decision gates based on person-rem dollar figures and an ALARA factor analysis that weighs nonquantitative parameters. The procedure is designed to be used by job planners, design engineers, or other personnel, with appropriate consultation by qualified health physicists. 2 figs.

46317 **Reminiscences of a mouse specific-locus test addict.** Russell, W.L. (Oak Ridge National Lab., TN (USA)). *Environmental and Molecular Mutagenesis (USA),* : 16-22 (1989).

This paper describes some of the historical events surrounding the development of and achievements with the mouse specific-locus test in radiation and chemical mutagenesis. Some ongoing and future contributions of the test to research in molecular genetics are also mentioned.

46318 **Chelation of ^{238}Pu(IV) in vivo by 3,4,3-LICAM(C): Effects of ligand methylation and pH.** Durbin, P.W. (Lawrence

Berkeley Lab., CA (USA)); White, D.L.; Jeung, N.L.; Weitl, F.L.; Uhlir, L.C.; Jones, E.S.; Bruenger, F.W.; Raymond, K.N. *Health Physics (USA)*, 56(6): 839-855 (Jun 1989).

The linear tetracarboxycatecholate ligand, 3,4,3-LICAM(C) N1,N5,N10,N14-tetrakis(2,3-dihydroxy-4-carboxybenzoyl-tetraaza tetradecane, tetra sodium salt) injected within 1 h after injection of Pu(IV) citrate, removes about the same fraction of Pu from animals as CaNa3-DTPA but removes less inhaled Pu than CaNa3-DTPA and leaves a Pu residue in the renal cortex. However, the formation constant of the expected Pu-3,4,3-LICAM(C) complexes are orders of magnitude greater than that of Pu-DTPA, and 3,4,3-LICAM(C) is 100 times more efficient than CaNa3-DTPA for removing Pu from transferrin in vitro. Because the formation constants of their actinide complexes are central to in vivo actinide chelation, ligand design strategies are dominated by the search for ligands with large Pu complex stabilities, and it was necessary to explain the failure of 3,4,3-LICAM(C) to achieve its thermodynamic potential in vivo. All the batches of 3,4,3-LICAM(C) prepared at Berkeley or in France [Euro-LICAM(C)] were found by high-pressure liquid chromatography to be mixtures of the pure ligand [55% in Berkeley preparations, 8.5% in Euro-LICAM(C)] and its four methylesters. A revised synthesis for 3,4,3-LICAM(C) is appended to this report. All of the incompletely hydrolyzed 3,4,3-LICAM(C) preparations and the pure ligand were tested for removal of Pu from mice [238Pu(IV) citrate intravenous, 30 mumol kg-1 of ligand at 1 h, kill at 24 h, radioanalyze tissues and separated excreta]. The presence of methylesters did not significantly impair the ability of the ligands to remove Pu from mice, and it did not alter the fraction of injected Pu deposited in kidneys. Temporary elevation (reduction) of plasma and urine pH of mice by 0.5 mL of 0.1 M NaHCO3 (NH4Cl) injected before or simultaneously with pure 3,4,3-LICAM(C) somewhat improved (significantly reduced) Pu excretion but had little influence on Pu deposition in kidneys.

5603 Chemicals Metabolism and Toxicology

Refer also to citation(s) 44510, 44916, 45183, 46099, 46103, 46122, 46170, 46177, 46178, 46179, 46317

46319 (ACOH/SD–1988) **Report on H_2S toxicity.** Alberta Community and Occupational Health, Edmonton, AB (Canada). Occupational Health and Safety Div. 1988. 75p. (MICROLOG–89-02221). Available from Alberta Health, 10030-107 St., 8th Floor, Seventh Street Plaza, Edmonton, AB, CAN T5J 3E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

An Alberta governmental committee was established to document and evaluate the known health effects of short-term exposures to hydrogen sulfide gas. Scientific evidence was reviewed for low level acute, subacute and chronic effects in the 0-100 ppM range, especially at the low end of that range, and to clarify the issue of the effects of low levels of hydrogen sulfide on sensitive individuals. Based on analysis of the literature, it seems clear that certain individuals may be more susceptible to the effect of hydrogen sulfide than others. Other factors may in part account for such hypersusceptibility, such as mixed exposure with other chemicals at the same time, pre-exposure to medications, and pre-existing and/or current diseases or medical conditions. Hydrogen sulfide by itself is a broad spectrum toxicant that can elicit numerous psychological and biological responses in the 0-20 ppM range. All organ systems respond variably to different hydrogen sulfide levels, with no level affecting all systems equally at the same time or rate. In general, single or repeated exposures of normal, healthy adults to hydrogen sulfide concentrations in the 0-5 ppM range have not resulted in clinically detectable irreversible biological or psychological effects. Although reversible adverse effects may result in temporary discomfort or changes in organ function, they have not been found to have a lasting impact to date. There remains a lack of good scientific data about the long term, low level chronic effects of hydrogen sulfide on community populations, hypersusceptible individuals, and workers in sour gas operations. 97 refs., 2 figs., 21 tabs.

46320 (AD-A–207987/9/XAB) **Army occupational health and AEJA (Army Environmental Hygiene Agency).** Kneessy, A.D. Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD (USA). May 1981. 10p. Available from NTIS, PC A02/MF A01.

The Army Environmental Hygiene Agency (AEHA) recently celebrated 38 years of continuous service in support of occupational health programs of the Army. This report briefly reviews its historical development, examine some of its current occupational and industrial hygiene programs, and touches on future program efforts. The Army Industrial Hygiene Laboratory, conducts surveys and investigations concerning occupational health hazards in Army-owned and operated industrial plants, arsenals and depots, and privately owned and operated ordnance explosive establishments. The end of World War II was the beginning of the nuclear age and attendant Medical Department responsibilities for radiation protection programs beyond the traditional concern for x-ray protection. The US Army has undertaken the demilitarization of obsolete and excess chemical munitions. The Medical Systems Safety and Health Branch is tasked to survey Army hospitals within the United States, to identify and recommend corrective action for safety and health hazards. At present, a continuing study is underway to evaluate the waste anesthetic gases to operating room personnel in Army hospitals. Noise-induced hearing loss is considered the most widespread occupational injury incurred by DA personnel.

46321 (AD-A–208175/0/XAB) **Upper bound on the-threshold crossing probability for short-time exposure dosage with implications for the assessment of hazard from toxic vapors. Memorandum report.** Yee, E.C. Defence Research Establishment Suffield, Ralston, AB (Canada). Mar 1989. 34p. (DRES-SM–1260). Available from NTIS, PC A03/MF A01.

The effects of most toxic substances (e.g., chemical and biological warfare agents) are cumulative in the sense that the response of the biological receptor (e.g., human lung) is dependent on the concentration of the noxious vapor integrated over the total exposure time, i.e., the total exposure dosage. An upper bound on the threshold-crossing probability of the random dosage field produced by the instantaneous or short-term release of a passive scalar (contaminant) into the turbulent atmospheric boundary layer is obtained. This bound is constructed by developing a model for the nonstationary stochastic process representing the fluctuations in the concentration of the contaminant as observed at some fixed receptor downwind of the source (i.e., the point of release of the scalar). The implications of this bound for the evaluation of the hazard posed by the release of toxic substances into the atmosphere is discussed. Here, it is emphasized that the neglect of fluctuations in the dosage can lead to significant underestimation of the risk of exposure to the toxic substance. Furthermore, it is speculated that the nature as well as the magnitude of the concentration fluctuations will have considerable impact on the protection levels that are provided by the current individual and collective protection equipment such as mask cannisters or filters and protective suits.

46322 (AD-A–208195/8/XAB) **Inhalation toxicology. 9. Times-to-incapacitation for rats exposed to carbon monoxide alone, to hydrogen cyanide along, and to mixtures of carbon monoxide and hydrogen cyanide. Technical report, January-November 1986.** Crane, C.R.; Sanders, D.C.; Endecott, B.R. Federal Aviation Administration, Washington, DC (USA). Office of Aviation Medicine. Jan 1989. 27p. (DOT/FAA/AM–89/4). Available from NTIS, PC A03/MF A01.

Laboratory rats were exposed to experimental atmospheres that contained (a) carbon monoxide in air, (b) hydrogen cyanide in air, and (c) mixtures of CO and HCN in air. The toxic potency of each of the three types of environments was evaluated toxico-kinetically be measurement of time-to-incapacitation as a function of toxic gas concentrations. Regression equations were derived that describe those relationships for exposure to CO or HCN alone. Analysis of the data from the combined-gas exposures, and comparison of that data with the results obtained from the exposures to each gas alone, lead to the conclusion that the toxicity of the combination is definitely greater than would be produced by either gas alone. There was, however, no evidence for a synergistic action–in which the effect of the combination would have been greater than that predicted from the sum of the two individual effects. An empirical

equation was derived that allows calculation of a predicted time-to-incapacitation for any combination of CO and HCN concentrations that are within the ranges utilized in the experimental exposures.

46323 (CONF-8908118–1) **Zooplankton population dynamics in experimentally toxified pond ecosystems.** Sierszen, M.E.; Boston, H.L.; Horn, M.J. Oak Ridge National Lab., TN (USA). 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 24. congress of the International Association of Theoretical and Applied Limnology; 13-19 Aug 1989. Order Number DE89016291/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

To evaluate ecosystem response to and recovery from toxic contamination, we added phenolic compounds to a series of experimental ponds. Toxicants were added repeatedly in a temporally staggered sequence to evaluate the influence of seasonal factors and previous exposure history on the responses to toxicant stress. We hypothesized that seasonal changes in ecosystem structure, e.g. shifts in the relative importance of "top-down" and "bottom-up" controls on energy flow, would influence the system-level responses to the toxicant. Information from these experiments is being incorporated into models that predict ecological risk and system-level behavior under toxicant stress. Here we focus on the responses of zooplankton populations to toxicants, and factors which may affect the apparent severity of toxic effects. 9 refs., 4 figs.

46324 (DLG–538031) **The inhibiting effect of calcium at higher pollutant burdens.** Schenkel, H. Deutsche Landwirtschafts-Gesellschaft e.V., Frankfurt am Main (Germany, F.R.). 1988. 50p. (In German). (CONF-8801168–1: DLG winter meeting, 12-13 Jan 1988). Order Number DE89910932/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01.

A brief survey on the influence of lead and cadmium on calcium metabolism, is followed by an illustration of the significance of a marginal calcium supply for the metabolism behaviour and the toxicity of the two heavy metals. Subsequently, on the basis of different bibliographical data, the paper discusses the possible protective effect of a calcium supplementation exceeding the demand in the case of a lead and/or cadmium exposure as well as the problem of the application of existing findings from animal experiments for practical hints for feeding. (orig./MG).

46325 (ETDE-mf–9914883) **Studies of the genetic alteration of forest trees due to acid precipitations. Short report.** Geburek, T.; Scholz, F. Bundesforschungsanstalt fuer Forst- und Holzwirtschaft, Grosshansdorf (Germany, F.R.). Inst. fuer Forstgenetik und Forstpflanzenzuechtung; Umweltbundesamt, Berlin (Germany, F.R.). [1986]. 12p. (In German). Contract UFOPLAN-Nr. 10607046/02. Order Number DE89914883/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Air pollution can change soil conditions, and cause selection in forest tree populations. To simulate the effects of toxic soil conditions a hydroculture system was developed and applied, by which quantification of selection effects is possible in Norway spruce (Picea abies). As toxic component aluminum was applicated in different molaric Ca/Al-rations. Subsets of plants showed a remarable individual variation in Al-sensitivity. Selection was traceable by the use of related plant material. Strong association between genetic parameters by isoenzyme analysis and Al-sensitivity were not always found. However, comparisons between genotypic and genic structures of seed-parents with sensitive and tolerant offspring respectively showed significant differences. The results let expect Al-induced selection on the genic level. Such selection can reduce the genetic multiplicity and can lessen the adaptability of forest tree populations to multiple natural and anthropogenous environmental conditions. (orig.).

46326 (ORNL/FTR–3344) **[Genetic toxicology in developing countries, Guadalajara, Mexico, July 19–24, 1989]: Foreign trip report.** Travis, C.C. Oak Ridge National Lab., TN (USA). 4 Aug 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016271/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended an International Conference on Genetic Toxicology in Developing Countries in Guadalajara, Mexico. The objective of the conference was to provide technical knowledge in the area of environmental toxicology to participants from the 23 developing countries represented. Conference participants identified the following top priorities to aid in the application of environmental toxicology principles in developing countries: (1) increased joint research activities in all aspects of science, (2) an increased number of training courses held in developing countries to facilitate exchange of experience and techniques, and (3) access to data bases in toxicological properties of chemicals.

46327 (PB–89-183057/XAB) **Studies on air pollution: Effects of nitrogen dioxide on airway caliber and reactivity in asthmatic subjects; effects of nitrogen dioxide on lung lymphocytes and macrophage products in healthy subjects; nasal and bronchial effects of sulfur dioxide in asthmatic subjects. Final report, 26 June 1987-26 November 1988.** Boushey, H.A.; Rubinstein, I.; Bigby, B.G. California Univ., San Francisco, CA (USA). Cardiovascular Research Inst. 13 Dec 1988. 53p. Available from NTIS, PC A04/MF A01.

The investigators performed three studies of the effects of NO_2 and SO_2 on airway function in human subjects. In 9 exercising asthmatic subjects, a 30-min exposure to 0.3 ppm nitrogen dioxide did not alter specific airway resistance, maximal expiratory flow, or the slope of phase III on the single breath test of nitrogen distribution and had no effect on airway hyperresponsiveness to sulfur dioxide. In the second study, repeated exposure of 5 healthy subjects to nitrogen dioxide was associated neither with any significant change in pulmonary function nor in the levels of secretory product of lung macrophages in bronchoalveolar lavage fluid. Analysis of the numbers and types of lymphocytes in venous blood and bronchoalveolar lavage fluid revealed no change apart from a small, possibly artifactual increase in natural killer cells in bronchoalveolar lavage fluid after NO_2 exposure. The third study examined whether brief exposures to moderately high concentrations of SO_2 caused acute increases in nasal symptoms and nasal resistance in 8 subjects with a history of both asthma and allergic rhinitis and with demonstrable bronchial hyperreactivity to SO_2.

46328 (PB–89-189773/XAB) **Effects of heavy metals in sediments on the macroinvertebrate community in the Short Creek/Empire Lake aquatic system, Cherokee County, Kansas: A recommendation for site-specific criteria. Technical report (Final).** Jobe, J. Kansas State Biological Survey, Lawrence, KS (USA). Oct 1988. 52p. Available from NTIS, PC A04/MF A01.

This study uses statistical analysis techniques to determine the effects of four heavy metals (cadmium, lead, manganese, and zinc) on the macroinvertebrate community using the data collected in the fall 1987. The concentrations of all four metals were found to be greatly elevated throughout Empire Lake and in both the Spring River and Shoal Creek arms of the reservoir. It is concluded that density and species richness were greatly reduced. The report also includes recommendations for the upper bounds for the sediment criteria of the four metals.

46329 (PB–89-200240/XAB) **Health-risk assessment of chemical contamination in Puget Sound seafood. Final report 1985-1988.** Williams, L. Tetra Tech, Inc., Bellevue, WA (USA). Sep 1988. 375p. (TETRAT-TC–3338-28). Available from NTIS, PC A16/MF A01.

This report provides resource management and health agencies with a general indication of the magnitude of potential human health risks associated with consumption of recreationally harvested seafoods from Puget Sound. Data collection and evaluation focused on a variety of metal and organic contaminants in fish, shellfish and edible seaweeds from 22 locations in the Sound. EPA risk assessment techniques were used to characterize risks to average and high consumer groups for both carcinogens and noncarcinogens. Theoretical risks associated with consumption of both average and high quantities of Puget Sound seafood appear to be comparable to or substantially less than those for fish and shellfish from other locations in the United States.

46330 (PB–89-201875/XAB) **Pentachlorophenol: health and environmental effects profile.** Choudhury, H.; Coleman, J.; De

Rosa, C.T.; Stara, J.F. Environmental Protection Agency, Cincinnati, OH (USA). Office of Environmental Criteria and Assessment. 1986. 91p. (EPA–600/J-86/503). Available from NTIS, PC A05/MF A01.

Pub. in Toxicology and Industrial Health, Vol. 2, No. 4, 483-571(1986). See also PB–89-124473.

Pentachlorophenol is used as an industrial wood preservative for utility poles, crossarms, fence posts, and other purposes (79%); for NaPCP (12%); and miscellaneous including mill uses, consumer wood preserving formulations and herbicide intermediate (9%). Photolysis and microbial degradation are the important chemical removal mechanisms for pentachlorophenol (PCP) in water. Direct photolysis may be an important environmental sink for PCP present in the atmosphere. Soil-degradation studies indicate the PCP is biodegradable; microbial decomposition is an important and potentially dominant removal mechanism in soil. Monitoring studies have confirmed the widespread occurrence of PCP in surface waters, groundwater, drinking water and industrial effluents. Subchronic and chronic toxicity studies show adverse effects in the liver, kidney and immune system. Inadequate evidence exists for carcinogenicity.

46331 (PB–89-866040/XAB) **Toxic substances: Effects on fish. January 1978-July 1989 (Citations from Pollution Abstracts). Report for January 1978-July 1989.** National Technical Information Service, Springfield, VA (USA). Jul 1989. 154p. Available from NTISPC N01/MF N01.

Supersedes PB–88-867056.

This bibliography contains citations concerning the biochemical and physiological effects of toxic substances on fish populations. Particular emphasis is placed on using fish as an indicator of pollution in aquatic ecosystems. Toxicity effects of mercury, zinc, calcium chloride, sodium chloride, lead, cadmium, copper, and aluminum in freshwater and seawater fish are included. (This updated bibliography contains 330 citations, 66 of which are new entries to the previous edition.)

46332 (UCRL–100511) **Managing human exposure and health risks: An integrated approach and the role of uncertainty.** McKone, T.E. Lawrence Livermore National Lab., CA (USA). Mar 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890909–1: 8. world clean air congress and exhibition, 11-15 Sep 1989). Order Number DE89008611/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Human populations contact environmental pollutants through food,water, and air in varying amounts each day throughout a lifetime. A realistic strategy for managing health risks of environmental contaminants therefore requires a comprehensive and integrated approach. Using examples for exposure to contaminants in potable water and to contaminants transferred from air to food, this paper considers two important issues in exposure assessment – the completeness of current exposure models and the treatment of uncertainty in exposure estimates. The results indicate that risk managers should consider the potential for multiple pathways, avoid risk assessments derived from single value estimates, be aware of the uncertainty in risk estimates, and include this awareness in their decisions.

46333 Effects of sulfur dioxide or ammonium sulfate exposure, alone or combined, for 4 or 8 months on normal and elastase-impaired rats. Smith, L.G. (Pacific Northwest Laboratory, Richland, WA (USA)); Busch, R.H.; Buschbom, R.L.; Cannon, W.C.; Loscutoff, S.M.; Morris, J.E. *Environmental Research (USA)*, 49(1): 60-78 (Jun 1989).

Normal and lung-impaired rats were compared after exposure to SO2 and/or (NH4)2SO4 for 4 or 8 months, or for 8 months plus 3 months recovery. Young adult male Sprague-Dawley rats were pretreated intratracheally with either physiologic saline (normal lungs) or porcine pancreatic elastase (impaired lungs). Rats from each pretreatment group were exposed to filtered air (control), to SO2 (1 ppm) or (NH4)2SO4 (0.5 mg/m3), or to combined SO2 + (NH4)2SO4 for 5 hr/day, 5 days/week. Morphologic, physiologic, and immunologic criteria were evaluated. At 4 months cellular immunologic responsiveness was not impaired, but physiologic changes were detected. Morphologic changes were apparent in all time periods. Elastase-induced changes included greater lung volumes, emphysema, and alveolar interstitial fibrosis. Pollutant effects included bronchiolar epithelial hyperplasia and changes in alveolar mean chord length (MCL). Relative to controls, bronchiolar epithelial hyperplasia and MCL increased in saline/pollutant groups, but decreased in elastase/pollutant rats at 4 months. The pretreatment/pollutant interaction was not observed at 8 months. Elastase effects persisted throughout the recovery period. Pollutant effects were more transitory, although alveolar septal fibrosis was greater in saline/(NH4)2SO4 rats at 8 months. Pulmonary function changes associated with elastase included increases in residual volume, functional residual capacity, and the residual volume/total lung capacity ratios. The alveolar plateau of single-breath washout (N2 slope) was significantly steeper in elastase-treated rats but less steep in animals exposed to SO2 or to (NH4)2SO4 than in those exposed to air only.

46334 Origins of genetic toxicology and the Environmental Mutagen Society. Wassom, J.S. (Oak Ridge National Lab., TN (USA)). *Environmental and Molecular Mutagenesis (USA)*, : 1-6 (1989).

A brief history of events that contributed to the establishment of genetic toxicology as a distinct research area and influenced the formation of the Environmental Mutagen Society is presented.

46335 Reciprocal relationship between mouse germ-cell mutagenesis and basic genetics: From early beginnings to future opportunities. Russell, L.B. (Oak Ridge National Lab., TN (USA)). *Environmental and Molecular Mutagenesis (USA)*, : 23-29 (1989).

The scientific foundations for several mammalian germ-line mutagenesis tests in common use today were laid in the 1930s, 1940s, and early 1950s. Subsequent developments in the field have had multiple objectives: detection of mutagenicity of environmental agents (which has led to the development of numerous methodologies), identification of biological and physical factors that affect mutation yield, analysis of the structural nature of the genetic alterations, and assessment of the organismic effects of various types of mutations. Mutagenesis studies have made numerous contributions to basic genetics by generating mutant types that led to elucidation of sex-determining mechanisms in mammals; formulation of the single-active-, or inactive-, X-chromosome hypothesis; correlation of genetic and cytological maps; discovery of genetic "imprinting" phenomena; study of developmental pathways and cell lineages, etc. Particularly useful are sets of complexly overlapping deletions that have been recovered in radiation mutagenesis studies, propagated in breeding stocks, and genetically analyzed; these have constituted prerequisites for molecular genetic studies aimed at development of the DNA structure-function relationships for important genomic regions. Mutagenesis experiments have also served to identify mutagens that are particularly effective in inducing specific types of genetic lesions desired for basic studies. Reciprocally, basic genetics has contributed to the development of mutagenesis tests and has enhanced the value of the specific-locus test by adding to its quantitative capabilities the capability for qualitatively characterizing the actions of mutagens.

5604 Other Environmental Pollutant Effects

Refer also to citation(s) 45009

46336 (AD-A–207747/7/XAB) **Preliminary model of the distribution of laser-induced retinal lesions resulting from eye and head responses. Interim report, Julu 1987-January 1988.** Kosnik, W.D. Krug International, San Antonio, TX (USA). Technology Services Div. Nov 1988. 27p. Available from NTIS, PC A03/MF A01.

A computer program was developed to simulate a pilot's reaction to an ocular exposure from a multiple-pulse laser. The simulation outlines five different scenarios of eye and head responses that are likely to occur in response to a laser exposure. These responses are: (1) closing the eyes; (2) centering the laser image on the fovea with a saccadic eye movement; (3) executing a saccade to avoid foveating the laser beam; (4) holding the eyes stationary relative to the laser beam; and (5) tracking a moving object during the laser exposure. The simulation modeled the effects of a 1-s laser exposure with pulse rates of 5,15, or 30 pulses/s and beam angles of 0, 10, 20, or 30 deg eccentric from the point of fixation. The output of the simulation predicted the number and distribution of lesions in

terms of retinal topography and acuity under the aformentioned conditions. The results of the simulation demonstrated that the pilot's reactions significantly influenced the number and pattern of lesions deposited on the retina. The most serious threat to vision resulted from an eye improvement that foveated the laser. Eye movements that diverted the laser from the fovea appeared to minimize the impact on vision. However, further work will be needed to quantify the size and location of athe visual field loss.

46337 (AD-A–207945/7/XAB) **Transient visual effects of prolonged small spot foveal laser exposure. Report for January-March 1989.** Zwick, H.; Robins, D.O.; Magsood, N. Letterman Army Inst. of Research, San Francisco, CA (USA). Mar 1989. 19p. (LAIR–373). Available from NTIS, PC A03/MF A01.

In recent experiments, the authors evaluated the effects of acute, threshold damage levels of small-spot foveal laser exposure. These experiments revealed transient changes in acuity and contrast sensitivity lasting from 10 to 15 minutes postexposure. Following recovery from such effects, normal acuity and contrast sensitivity are not necessarily degraded, although continuous exposure at these levels does result in parafoveal compensation for foveal damage and eventual deficit in fine visual acuity. Development of a test of foveal function during and after small-spot foveal exposure was the primary objective of this investigation. This objective was accomplished. At retinal damage levels, only a small focal foveal lesion was observed indicating the ability to utilize the fovea during such exposure. Post-exposure recovery effects analyzed for target size and contrast conditions suggest retinal and possibly cortical saturation processes.

46338 (DOE/RA/50219–T9) **[Study of the behavioral and biological effects of high intensity 60 Hz electric fields]: Quarterly technical progress report No. 29.** Orr, J.L. Southwest Research Inst., San Antonio, TX (USA). 14 Jul 1989. 141p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC02-80RA50219. (SWRI–12-6253). Order Number DE89015528/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

Activities this quarter involved all phases of the project plus a meeting of the Joint Committee in Tokyo. Detailed mapping of the exposure facility is scheduled to be completed during the week of August 14, 1989. Both electric and magnetic fields should be available for tests of the components of the tether and blood sampling system for the neuroendocrine pilot study in September 1989. The groups for the social behavior study are stabilizing appropriately. Details on the formation of the groups and their status has been provided. Dr. Coelho has included information related to aspects of the social experiment ranging from age estimation in baboons through the cardiovascular consequences of psychosocial stress. In addition, a draft manuscript is included on the data from the previous experiments which describes the effects of 30 and 60 kV/m electric fields on the social behavior of baboons. Tests of the blood handling procedures and analysis methods have been completed. With the exception of the catecholamine analyses, the handling procedures and variability in replicate measurements are satisfactory. Logistic and practical considerations now weigh strongly against including the analysis of the blood samples for catecholamines. Preliminary tests indicate that a sampling procedure which will work for the other compounds is probably not satisfactory for the catecholamines.

46339 (OH/RD–88-121-K) **Guidelines for residential source characterization program.** Harvey, S.M. Ontario Hydro Research Div., Toronto, ON (Canada). 1988. 7p. (MICROLOG–89-02600). Available from Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Two epidemoilogical studies carried out in the Denver area have raised the hypothesis that increased levels of power-frequency magnetic fields in residences may be associated with increased incidences of childhood cancer. This hypothesis is based on the use of a surrogate method of estimating the historical level of residential magnetic field, using the physical characteristics of the nearby distribution wiring rather than actual magnetic field measurements. While some relationship between the magnetic fields in a house and the currents in nearby wires will clearly exist, the actual extent to which particular internal or external conductors will contribute to the residential environment, and by what mechanism, is not well understood. Until this information is available, the validity of he surrogate method is questionable and the above hypothesis must remain untested, at least in the short term. Two recent residential magnetic-field surveys designed to test the accuracy of surrogate wiring-code estimates in ranking homes are analyzed, and the results are used to suggest guidelines for the Source Characterization program. 4 refs., 1 tab.

57 HEALTH AND SAFETY

Refer also to citation(s) 44734

46340 (UCRL–101717) **Exposures of totally-encapsulating chemical protective suits to high and very high concentrations of hydrogen fluoride along with future experimental plans.** Johnson, J.S.; Swearengen, P.M. Lawrence Livermore National Lab., CA (USA). 10 Aug 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890814–3: American Institute of Chemical Engineer's summer national meeting, 20-23 Aug 1989). Order Number DE89016514/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We conducted a series of tests on nine commercial brands of totally-encapsulating chemical protective (TECP) suits under realistic worst-case exposures to hydrogen fluoride (HF). Most of the tests were carried out using a static mannequin in a large wind tunnel located at the US Department of Energy Liquefied Gaseous Fuels Spill Test Facility at the Nevada Test Site. Several tests were also conducted using another mannequin that articulated at the waist. HF leak-rates into the TECP suits were measured using an integrated field sampler and silica-gel sorbent tubes. At HF concentrations of ~10,000-30,000 ppM, we observed no significant TECP suit leakage. We experienced no field problems in conducting ASTM F1052-87 TECP pressure leak-rate tests. Several tests to determine if positive-pressure vent valves significantly improve TECP suit performance indicated little, if any, difference in leak-rate as compared to the standard vent valves. One final TECP suit exposure to very high concentrations of HF (>500,000 ppM) resulted in a major suit failure. Future laboratory and field experiments are planned to determine why this failure occurred, as well as to better define an experimental method to carry out worst-case TECP suit chemical exposures. 10 refs., 7 figs., 6 tabs.

58 GEOSCIENCES

5801 Geology and Hydrology

Refer also to citation(s) 44470, 44471, 44653, 44654, 44655, 44656, 44657, 44675

46341 MUCK - a novel approach to co-kriging. Clark, I. (Geostokos Ltd., London (England)); Basinger, K.L.; Harper, W.V. pp. 658 of Geostatistical, sensitivity, and uncertainty methods for ground-water flow and radionuclide transport modeling. Proceedings. Buxton, B.E. (ed.) Battelle Memorial Institute, Columbus, OH (1989). From Geostatistical sensitivity and uncertainty methods for groundwater flow and radionuclide transport modeling conference; 15-17 Sep 1987.

Multivariate geostatistical estimation - co-kriging - has been used in practice for well over a decade. The technique as developed by Matheron has been documented in many case studies. There are disadvantages to the standard approach, however, not the least of which is that the variables which are measured must be sited at the same geographical location. For example, they will tend to measure all of them on the same samples. There are cases in which this type of information is not available. Indeed, the motivation for using a multivariate approach may be to specifically improve estimation in areas where few variables have been measured. A variation in co-kriging will be presented which does not place this restriction on the modeling and estimation processes. A case study will be given which includes the added complication of strong trend. Hence the acronym for this new method - Multivariate Universal Co-Kriging.

46342 (GS–89-1H) **Current research, part H. Frontier geoscience program, Queen Charlotte Islands, British Columbia.** Geological Survey of Canada, Ottawa, ON (Canada). 1989. 152p. (MICROLOG–89-02837). Available from Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

This compilation of reports from a program examining various aspects of the geology of the Queen Charlotte Islands includes papers on regional structure, stratigraphy, fossils, igneous intrusions, geochronometry, sedimentation, thermal structure, gravity measurements, and hydrocarbon potential. Separate abstracts have been prepared for three papers from this compilation. 3 conf. papers

46343 (GS–89-1H, pp. 87-94) **Sedimentological aspects of the Skonun Formation, Queen Charlotte Islands, British Columbia.** Higgs, R. (Cordilleran and Pacific Geoscience Div., Sidney, BC, Canada). Geological Survey of Canada, Ottawa, ON (Canada). 1989. (MICROLOG–89-02837). In *Current research, part H. Frontier geoscience program, Queen Charlotte Islands, British Columbia.* Available from Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Oil-company boreholes in the Queen Charlotte Basin reveal a Miocene-Pilocene succession (Skonun Formation) up to 5 km thick, containing abundant sand bodies with reservoir potential. However, the depositional environment of the Skonun Formation, hence the geometry of the sand bodies, is poorly understood, partly because exposures and core are minimal. Three exposures are described. The facies include coal beds and rooted mudstones; these are interpreted as delta-plain deposits, suggesting that some of the subsurface sand bodies could be distributary channels and delta-front sands. Similarly, tidal-shelf sandstones are present at outcrop, suggesting that linear tidal sand ridges could occur at depth. Implications for hydrocarbon exploration are discussed. Iceberg dropstones occur in probable Upper Miocene strata at one locality, despite faunal evidence that the climate was temperate. This is thought to indicate that the northern Coast Mountains of British Columbia were sufficiently high in Late Miocene time to produce glaciers capable of reaching the sea. 20 refs., 5 figs.

46344 (ISPG–85-28) **Stratigraphy and structure of the mount Selwyn area, Rocky Mountains, northeastern British Columbia.** McMechan, M.E. Institute of Sedimentary and Petroleum Geology, Calgary, AB (Canada). 1987. 40p. (MICROLOG–87-04835). Available from Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $14.00; OTHER COUNTRIES: $16.80 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Upper Proterozoic to Middle Jurassic, miogeoclinal, clastic and carbonate deposits, Upper Jurassic to Lower Cretaceous foredeep deposits, and Upper Cretaceous to Tertiary intermontane basin deposits outcrop in the Mount Selwyn area. Three structural levels, each characterized by distinctive structural styles, are recognized in the Rocky Mountains. Middle Devonian and older strata of the lower structural level form larger thrust sheets and folds. Predominantly incompetent, disharmonically folded and faulted Upper Devonian to Middle Triassic strata of the middle structural level have been shortened approximately twice as much as the folded , more competent, Upper Triassic to Upper Cretaceous strata of the upper structural level across the Foothills belt. Shortening across the Rocky Mountains is approximately 70 km. Pre-late Cretaceous strata exposed adjacent to and within the Rocky Mountain Trench were regionally metamorphosed to greenschist facies and penetratively deformed prior to Late Cretaceous-Paleocene thrust faulting in the Rocky Mountains. The disappearance of folded and faulted Upper Cambrian to Middle Devonian strata, and the folding of major thrust faults in the southern part of the Mount Selwyn area are probably a consequence of southeastward convergence in the position of ramps through Upper Proterozoic to Middle Devonian strata in the hanging walls of the Murray Range and Hidden faults, and the juxtaposition of the intervening deformed wedge of rock along a flat in the footwall of the Hidden Fault. Prospective structures for petroleum accumulation may occur at the leading edges of the "blind" (nonsurfacing) thrust sheets carrying Middle Devonian and older strata under the western part of the Foothills, and in faulted anticlines of Lower Carboniferous carbonate strata. 105 refs., 20 figs.

46345 (SGS–9, pp. 53-67) **Macrofossils and stratigraphic subdivisions of the Bakken Formation (Devonian-Mississippian), Williston Basin, North Dakota.** Thrasher, L.C. (U.S. Bureau of Land Management, Dickson, NS, USA). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Over 500 macrofossils representing more than 50 taxa were collected from 39 cores in this study. Brachiopods, the most common, represent 17 genera, 11 of which have not been previously reported from the Bakken Formation. The fossils were found mostly within five stratigraphic intervals, each containing a different fauna. The basal few feet of the lower shale member locally contains a benthic rhynchonellid fauna that appears similar to fossils from near the base of Devonian black shales in the eastern USA. Foerstia sp., found in the basal 20-30% of the lower shale member in one core, appears to mark a widespread time-stratigraphic interval of Late Devonian age. Cyzicus (Lioestheria) sp. is prolific in the upper few inches of the lower shale near the Basin center; this species is concentrated at a similar interval in correlatives of the Bakken that crop out in the western interior region. The other fossiliferous intervals of the Bakken occur in the middle member and are found in association with lithologies that are used here to divide the middle member into three stratigraphic units. The lowest of these contains a Syringothyris similar to that of a Mississippi Valley limestone and to that in the siltstones of of Bakken correlatives in the western USA, both of latest Devonian age. The middle unit is poorly fossiliferous and an early Mississippian age is suggested. The top unit contains brachiopods that seem to correlate with those of early Mississippian age in other areas. It is suggested that these beds were deposited after a reorientation of the Bakken sea. Macrofossils in the upper shale member are generally small, thin-shelled and rare. 47 refs., 12 figs., 1 tab.

46346 (SGS–9, pp. 17-21) **Factors determining the thermal history of a continental basin.** Gosnold, W.D. (Univ. of North Dakota, Grand Forks, ND, USA); Huang, Y.C. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

In theory, the thermal maturity of petroleum source rocks should be calculable if one can accurately determine the temperature profile for the source rock through time. Approaches using present day geothermal gradients or thermo-mechanical models have provided insight into aspects aspects of the thermal evolution of sedimentary basins. Problems in modeling basinal thermal history are addressed by analyzing the factors that control temperature profiles. A model for thermal evolution of the Williston Basin is used as an example of the effects of thermal conductivity structure and time-variation of thermal conductivity. The cccin can be divided into a high-conductivity, Paleozoic carbonate section and a low-conductivity, Mesozoic and Cenozoic clastic section. This structure causes a geothermal gradient profile that essentially has two components. The marked vertical variation in geothermal gradient structure precludes use of bottom-hole temperature data for estimating the thermal history of strata in the basin. Variation in sediment thermal conductivity in time is one-directional and is significantly influenced by sedimentation rate, compaction rate, and sediment composition and thickness. Thermal conductivity of the low-conductivity Basin

sediments increased ca 30% due to compaction during sedimentation. This time-varation in conductivity caused a gradual reduction in subsurface temperatures by about 20 degrees in the primary oil source rock during the early Tertiary. Application of the two-dimensional thermal model that includes variable thermal properties predicts a significantly different thermal maturity for the basin than does a simple model based on present geothermal gradients. 24 refs 3 figs 2 tabs

46347 (SGS–9, pp. 22-36) **Earliest Paleozoic history of the Williston Basin in North Dakota.** Lefever, R.D. (Univ. of North Dakota, Grand Folks, ND, USA); Thompson, S.C.; Anderson, D.B. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

The Deadwood Formation in the North Dakota (ND) portion of the Williston Basin ranges in thickness from zero to more than 270 m and represents the earliest recorded Paleozoic deposition in that area. Six correlatable units can be recognized. The Deadwood consists largely of siliciclastic rocks, and was deposited under marginal marine to offshore conditions. The Winnipeg Group unconformably overlies the Deadwood over most of ND and attains a maximum thickness of a 135 m in the centre of the Basin. The Group consists of three formations which are, in part, lateral facies equivalents. The initial subsidence of the Basin in ND occured at a time no later than late Tremadocian, and does not appear to have been associated with major orogenic events elsewhere in North America. The area of greatest subsidence seems to have been initially elongate, and to have become more circular by Winnipeg time. The Deadwood was deposited during a gradual major eustatic sealevel rise, which included several smaller-scale transgressive and regressive episodes. A major eustatic sealevel drop occurred at the end of the early Ordovician. Marine deposition in ND ceased, and Deadwood strata were eroded from the newly exposed areas of the Basin. By the late Ordovician, sealevel was rising again. In ND, the first evidence is the fluvial-deltaic deposits of the lower Black Island Formation, deposited in the area with the greatest amount of subsidence. With continued sealevel rise, these deposits were covered, and the shallow marine sandstones of the upper Black Island were deposited, followed by the deeper marine shales of the Icebox Formation and, finally, the argillaceous limestones of the Roughlock Formation. 52 refs 8 figs 1 tab

46348 (SGS–9, pp. 47-52) **Distinguishing between depositional and dissolution thinning. Devonian Prairie Formation, Williston Basin, North America.** Oglesby, C.A. (Colorado School of Mines, Golden, CO, USA). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Abrupt lateral thickness variations within the Prairie Formation are common and caused by two disparate but distinguishable processes: differential accumulation of salt during deposition and differential removal of salt by dissolution. Recognition and prediction of dissolution and depositional thin areas are important to petroleum exploration and development. Indirect methods, utilizing well logs, provide the primary method for interpreting occurrences of the two processes. The results of this study indicate that the two processes can be distinguished using Prairie intraformational correlations. There are several regionally correlative shoaling upward sequences within the Prairie Formation. The lowermost begins with the transition from the Winnipegosis Formation laminated carbonates to the basin-centered Ratner anhydrite, followed by halite and culminating in the Esterhazy potash beds. Two overlying sequences also display shallowing upward trends. A fourth sequence is indicated by several additional feet of halite capping the Patience Lake member in some parts of the basin. Cross-sections show a regional, gradual decrease in thickness in the lower Prairie away from the basin depocenter, most simply explained by decreasing the subsidence rates away from the center and by depositional onlap of the Prairie toward the basin margins. By correlating the 4 sequences within the Prairie, some local thickness variations are shown to originate by depositional onlap onto Winnipegosis reefs. In other instances, the basal parts of the formation are preserved but the upper parts are progressively restricted. This pattern is explained by progressive dissolution of Prairie evaporites from the top downward. 18 refs., 10 figs.

46349 (SGS–9, pp. 190-195) **Late cenozoic erosion of Williston Basin sediments.** Clausen, E.N. (Minot State Univ., Minot, ND, USA). Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

Evidence for deep erosion of sediments in the Williston Basin region incudes an erosion surface cutting across numerous stratigraphic units, a system of major escarpments, erosional remnants of previous topographic surfaces, and high-level drainage divides covered with alluvial sediments. Glacial erosion, aided by tremendous volumes of meltwater, probably scoured out systems of extremely wide and shallow glacial troughs on the northern Great Plains. These valleys are cut in the easily-eroded claystone bedrock of the region. Late Cenozoic climatic models indicate as many as 25 major glacial episodes during the past 3.2 million years. Continental icesheets probably advanced into the Williston Basin region during most, if not all, of those glacial episodes. Alpine icecaps probably covered the Rocky Mountain uplands during each of the glacial episodes. Meltwater from these alpine icecaps repeatedly crossed the Williston Basin region only to be diverted along the margins of continental ice sheets. Glacial meltwater rivers, emanating from alpine icecaps in the Rocky Mountain region, carried distinctive glacio-fluvial alluvium. Gravels, capping upland regions in eastern Montana and the western Dakotas and elsewhere were probably deposited when rivers, carrying such glacio-fluvial material, were diverted along continental ice margins. Evidence for early diversion of one such river, the Yellowstone River, can be found along the asymmetric drainage divide east of the Little Missouri River. Buttes, composed of sediments usually mapped as (Oligocene) White River Group, probably represent topographic inversions of early Yellowstone River valleys. The distinctive sediments record both the diversions of the rivers and the progressive lowering of the Williston Basin region landscape. 30 refs 1 tab

46350 (SGS–9, pp. 266-267) **Salinity, oxygenation, and topographic controls on Mississippian subtidal sedimentation in a portion of the Mission Canyon Formation, Williston Basin, North Dakota.** Fischer, H.J. (Univ. of North Dakota, Grand Forks, ND, USA); Luther, M.R.; Eylands, K.E.; Quinn, C.F. Saskatchewan Geological Society, Regina, SK (Canada). 1987. (CONF-8706400–: 5. international Williston Basin symposium, 14-17 Jun 1987; MICROLOG–87-06204). In *Proceedings of [the] fifth international Williston Basin symposium.* Available from Saskatchewan Geological Society, P.O. Box 234, Regina, SK, CAN S4P 2Z6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

A model is presented for the deposition of sublittoral rocks from the Mission Canyon Formation in the Billings and Bottineau-Renville County areas of North Dakota. The model calls for salinity to be the major factor controlling sedimentation patterns; the carbonate section developed during Mission Canyon time in response to a general increase in salinity with time, punctuated by rapid, periodic fluctuations in salinity that controlled lithofacies distribution within the carbonate succession. Local changes in other parameters accentuated effects of salinity changes and controlled local variations in lithology, organism distribution, sedimentary structures, and evaporate mineral distribution. The lateral, band-like distribution of facies

from the seaward to the landward parts of the formation is explained by bodies of water with different salinities and oxygen values, as explained by salinity gradients being established away from the margin of the epicontinental sea. Lateral migration of the salinity bands would cause vertical stacking of sediments showing different degrees of restriction as a particular chemical environment caused a specific lithofacies to form in a given area. 7 refs.

5802 Geophysics

Refer also to citation(s) 44607, 44773, 46055

46351 (CEA-DAS-602) **Historical seismicity in Morocco: methodological aspects and cases of multidisciplinary evaluation.** Elmrabet, T.; Ramdani, M.; Tadili, B.; Levret, A. CEA Centre d'Etudes Nucleaires de Fontenay-aux-Roses, 92 (France). Dept. d'Analyse de Surete. May 1989. 22p. (CONF-8904264--: Symposium on the seismicity, seismotectonic and seismic risk of the Ibero-Maghrebian region, 12-14 Apr 1989). Order Number DE89908182/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Within the framework of a cooperative agreement between Sofratome and the Office National d'Electricite of Morocco, the Centre National de la Recherche of Rabat, with the collaboration of the French Institut de Protection et de Surete Nucleaire, was put in charge of compiling a revised catalogue of the historical seismicity of Morocco. The method adopted calls for the participation of several different disciplines in view of situating each earthquake in its own geographical and historical context. The approach entails, during the first stage involving primarily the historian, gathering together the original sources of data and subjecting them to a critical analysis in order to assess their reliability. The second stage consists in interpreting the information so as to define those earthquake characteristics that are requisite to seismic hazard studies. This latter evaluation must be the fruit of a multidisciplinary effort. This is particularly true for earthquakes of past centuries, the observations of which are frequently incompatible or biased and accordingly need to be substantiated by referring to information of a varying nature and, wherever possible, calibrated using accurate data from recent events. In a number of instances, duplications are encountered, or lumped effects for distinct events due to calendar misreckonings, erroneous copying, or misconceptions relative to the geological or historical context. A particularly significant example of the interference of these diverse aspects is afforded by the assessment of the destructive effects in Morocco of the 1755 'Lisbon' earthquake: a method is proposed for calibrating its intensities by comparing them with those of the recent 1969 event of similar origin.

46352 (EGG-10617-6065) **Systems control and receiving station: Quarterly report, April-June 1989.** Harrer, S.J. EG and G Energy Measurements, Inc., Albuquerque, NM (USA). Kirtland Operations. Jun 1989. 19p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC08-88NV10617. (KO-297-89). Order Number DE89016314/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

During this quarter the Norwegian Experimental Seismic System (NORESS) lost 171 hours and 37 minutes of data. The System Control and Receiving Station (SCARS) is continuing its efforts to copy the NORESS and Regional Seismic Test Network (RSTN) data onto optical disk. This quarter SCARS received the remaining Arctic Experimental Seismic System (ARCESS) data that were initially agreed upon from Norwegian Seismic Array (NORSAR) on magnetic tapes. Satellite transmission of the data is not expected. The Receiving and Monitoring Station (RAMS) is continuing its efforts in the software development for the Deployable Seismic Verification System (DSVS). RAMS is also involved in the data analysis of the seismometers for the DSVS project and the hardware check out. SCARS received 30 data requests involving 126 events. There, was 1 RSTN data request for a total of 1 event, 12 NORESS data requests for a total of 89 events, 7 ARCESS data requests for a total of 22 events, and 10 Seismic Test Unit (STU) data requests for 14 events. 4 figs., 1 tab.

46353 (IKU-R-24.1493.00/02/88) **Shallow seismic digital navigation data base. Norwegian Continental Shelf.** Mogensen, R.; Westgaard, D.A. Institutt for Kontinentalundersoekelser og Petroleumsteknologi A/S, Trondheim (Norway). Nov 1988. 126p. Order Number DE89914755/JAW. Available from NTIS (US Sales Only), PC A07/MF A01.

The digital navigation data base contains information of available regional shallow seismic lines on the Norwegian Continental Shelf. In all, 103.856 km of shallow seismic lines have been registrated in the data base. The report describes and demonstrates how to find the data coverage in an area of interest. An overview of all the navigation registrated in this digital navigation data base is given. The report presents listings of all lines, descriptions of all surveys and a distance listing for each survey. The shelf has been divided in four areas: North Sea, Mid-Norway, Troms (North Norway) and Barents Sea. 1 reference, 8 tables.

5803 Mineralogy, Petrology, and Rock Mechanics

Refer also to citation(s) 44599

46354 (SAND-88-3482) **DMC [Distinct Motion Code]: A rigid body motion code for determining the interaction of multiple spherical particles.** Taylor, L.M.; Preece, D.S. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 38p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89016929/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The computer program DMC (Distinct Motion Code) determines the two-dimensional planar rigid body motion of an arbitrary number of spherical shaped particles. The code uses an explicit central difference time integration algorithm to calculate the motion of the particles. Contact constraints between the particles are enforced using the penalty method. Coulomb friction and viscous damping are included in the collisions. The explicit time integration is conditionally stable with a time increment size which is dependent on the mass of the smallest particle in the mesh and the penalty stiffness used for the contact forces. The code chooses the spring stiffness based on the Young's modulus and Poisson's ratio of the material. The ability to tie spheres in pairs with a constraint condition is included in the code. The code has been written in an extremely efficient manner with particular emphasis placed on vector processing. While this does not impose any restrictions on non-vector processing computers, it does provide extremely fast results on vector processing computers. A bucket sorting or boxing algorithm is used to reduce the number of comparisons which must be made between spheres to determine the contact pairs. The sorting algorithm is completely algebraic and contains no logical branching. 13 refs., 14 figs., 4 tabs.

5804 Geochemistry

Refer also to citation(s) 44599, 45627

46355 (CONF-8909173-1) **The solubility of gibbsite in aqueous sodium chloride solutions.** Palmer, D.A.; Wesolowski, D.J. Oak Ridge National Lab., TN (USA). 1989. 7p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 11. international conference on the properties of steam (ICPS); 3-9 Sep 1989. Order Number DE89016226/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Knowledge of the thermodynamic properties of aqueous aluminum as a function of pH, temperature and salinity is essential in understanding the hydrothermal behavior of this ubiquitous element. Experimental studies of the thermodynamics of dissolution and hydrolysis of aluminum have relevance in modeling aqueous solutions found in geothermal power generating wells, the formation of hydrothermal ore deposits and the corrosion of aluminum substrates. Due to the extremely insoluble nature of hydrolyzed aluminum in near neutral solutions, solubility experiments are one of the few means of obtaining much of this information. As confirmed in this study, gibbsite [$Al(OH)_3$] is a stable solid phase at near ambient conditions (<100°C) with apparently very slow kinetics of transformation to the more stable form, corundum (Al_2O_3). 24 refs., 2 figs.

46356 (DOE/ER/13721-T1) **Petrology and emplacement dynamics of the intrusive and extrusive rhyolites of Obsidian**

Dome Inyo Craters volcanic chain, eastern California. Vogel, T.A.; Schuraytz, B.C.; Eichelberger, J.C.; Stockman, H.W.; Westrich, H.R.; Younker, L.W.; Horkowitz, J.P. Michigan State Univ., East Lansing, MI (USA). Dept. of Geological Sciences. 1989. 71p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER13721. Order Number DE89016277/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

Drilling at Obsidian Dome has provided continuous core samples of the distal and proximal portions of Obsidian Dome, its conduit, and an associated feeder dike. Both the dome and conduit are chemically and mineralogically zoned and consist of a finely porphyritic, high-Ba, low-silica rhyolite occurring in the basal portion of the dome and margins of the conduit and a finely porphyritic, low-Ba, higher silica rhyolite in the upper portion of the dome and center of the conduit. The high-Ba rhyolite contains two distinct phenocrysts assemblages with two distinct compositions, and represents mingled magmas. The low-Ba rhyolite in the dome and conduit contains significantly fewer disequilibrium phenocrysts and is only slightly mingled. The dike, sampled at 600 m depth, as well as a related tephra fall from Obsidian Dome vent, are entirely low-Ba rhyolite that contain no evidence of magma mingling. End members of the mingled magma, calculated using two different methods, are a 63 percent silica end member, and a silicic end member identical in composition to the dike and tephra fall from Obsidian Dome vent. This silicic end member was the first magma emplaced in the dike, and comprised much or all of the first magma vented to the surface during formation of the Obsidian Dome vent when eruption rates were high. Magma mingling of mafic and rhyolite magmas occurred during formation of the conduit. 59 refs., 16 figs., 10 tabs.

46357 (EC/NHR/S–87004) **Turkey Lakes water study. Hydrogeological instrumentation and aquifer materials.** Johnston, L.M.; Craig, D. Environment Canada, Saskatoon, SK (Canada). National Hydrology Research Inst. 1987. 31p. (MICROLOG–88-06244). Available from Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.

57 wells (69 sampling points) ranging in depth from 0.5 to 9.7 m are currently in use in the Turkey Lakes Watershed ground water study. During the drilling program, 50 overburden samples were collected, freeze-dried and sieved into seven fractions. Each fraction was subjected to an acid-base titration to measure its relative acid neutralization capacity (ANC). The ANC, expressed as $\%CaCO_3$ by weight, increases with depth from 0.3% at one meter to 1.4% at seven meters. The average ANC value for each of the five main basins range from 0.6 to 1.3% by weight. X-ray diffraction analysis of the silt-clay fraction of selected samples showed quantities of montmorillonite and illite. 40 fractions, from 11 sites, contained inorganic carbon ranging from trace levels to 0.26% be weight. Organic carbon concentrations in the same fractions ranged from not detectable to 0.02%. Sulfur concentrations were below the detection limit of 0.02%. This report is intended to serve as a source of basic data for other scientists working in the area and provides a permanent record for the sites studied during the Long Range Transport of Atmospheric Pollutants Program. 14 refs., 5 figs., 5 tabs.

46358 Radiochemical study of biological crisis zones in the fossil record. Attrep, M. Jr. (Los Alamos National Lab., NM (USA)); Orth, C.J. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809240–: Symposium on application of nuclear techniques to geochemistry, 25-30 Sep 1988).

The authors have been measuring elemental abundances in rock samples across biological crisis zones in the fossil record using the Los Alamos automated neutron activation analysis system for about 40 trace and common elements with radiochemical methods for Os, Ir, Pt and Au. We began our study soon after the Alvarez team reported their discovery of an Ir anomaly at the Cretaceous-Tertiary (K-T) boundary in European marine rock sequences; they hypothesized a large-body impact cause. After finding the Ir anomaly and evidence of an abrupt plant extinction in nearby continental K-T sequences, we turned our emphasis in 1981 to other extinction boundaries, and to date we have examined at least one section of most of the boundaries that pre-date the K-T event. These studies are generally done in collaboration with paleontologists and stratigraphers. We have located several pre-(K-T) Ir anomalies which we have attributed to terrestrial processes. Thus far, the results of this work do not support the recent hypotheses which suggest that the reported periodic extinctions (26 Ma) were caused by impacts from cyclic comet swarms in the inner Solar system.

46359 Adsorption of cesium and strontium on untreated and organic-extracted shales. Ho, P.C. (Oak Ridge National Lab., TN (USA)). pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809278–: American Chemical Society Division of Nuclear Chemistry and Technology, 25-30 Sep 1988).

Adsorption of Cs(I) and Sr(II) on untreated and organic-extracted shales in synthetic ground waters under oxic conditions was studied. The selected shales were Green River Formation, Chattanooga, Pierre, and two Conasauga Shales; they represent mineralogical and compositional extremes of shales. Synthetic brine made to simulate groundwater in the Conasauga Shale, a 100/l dilution of this brine, and 0.03 M $NaHCO_3$ were used as ground waters. According to mineralogical studies, the first three shales contain 5 to 13 wt% of organic matter, and the two Consasauga Shales contain only trace amounts. Soxhlet extraction with chloroform and a chloroform/methanol mixture removed ca 5 wt% organic matter from the total organic content of the first three shales. Adsorption of trace quantities of Cs(I) and Sr(II) on these shales shows that the distribution coefficients with untreated shales were moderate with Cs(I) in concentrated brine, moderate with Sr(II) in all three solutions, and significant with Cs(I) in the diluted brine and carbonate solution. The distribution coefficients decreased greatly after the shales were extracted with organic solvents. The decrease of adsorption is proportional to the amounts of organic matter removed.

46360 ^{137}Cs radioactive dating of lake core sediments. Ward, T.E. (Brookhaven National Lab., Upton, NY (USA)); Breeden, J.; Komisarcik, K.; Porter, R.; Czuczwa, J.; McVeety, B. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809278–: American Chemical Society Division of Nuclear Chemistry and Technology, 25-30 Sep 1988).

The accurate knowledge of sedimentary geochemical processes and lake development can be obtained by studying the distribution of ^{137}Cs in sediment cores. ^{210}Pb dating and ambrosia pollen distributions compare well with ^{137}Cs techniques enabling determination of sedimentation rates with precision over the past 100 yrs or so in the Greater Lakes regions. The geochronology of environmental pollutants can be traced using this radiometric technique.

5805 Oceanography

Refer also to citation(s) 46182

46361 (NEI-NO–90, pp. 17) **System for automatized hydrographic surveying.** Ous, O.C. Norske Sivilingenioerers Forening, Oslo (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with a system for atomatized hydrographic surveying. The system consists of following units and arrangements: Hydrographic echo sounder; positioning processor directed towards both land-based and satellite-based navigation systems; recording unit wirh routines for the selection of relevant data on depth profiles and geology; post processing systems for the production of hydrographic originals in digital form and also bathymetric charts. 2 figures.

46362 (NEI-NO–90, pp. 6) **All-automated topographic seabed mapping.** Anda, B. Norske Stats Oljeselskap A.S., Stavanger (Norway). 1986. (In Norwegian). (CONF-8601153–: Experiences with offshore instrumentation, 29-31 Jan 1986). In *Experiences with offshore instrumentation.* Order Number DE89902379/JAW. Available from NTIS (US Sales Only), PC A13/MF A01 - Norske sivilingenioerers forening, pb. 2312 Solli, 0201 Oslo 2.

The paper deals with the development of an all-automated topographic sea bed mapping system used on the Norwegian continental shelf. The operation requirements for the various units in the system are described, and a digital surface model is used in the data processing.

46363 (ORNL/FTR–3342) **[Evaluation of the North Atlantic seasonal nitrogen model (Version 2)]: Foreign trip report, July 17–21, 1989.** Fasham, M.J.R. Oak Ridge National Lab., TN (USA); Institute of Oceanographic Sciences, Wormley (UK). 29 Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016157/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The results of version 2 of the three-dimensional North Atlantic Seasonal Nitrogen Model were compared with chlorophyll distributions derived from Coastal Zone Optical Scanner (CZOS) images and found to be in better agreement than the version 1 results. Also, the model gave a more realistic simulation of regenerated primary production, giving a geographically averaged f-ratio of 0.4 compared with 0.78 for version 1. Although the qualitative agreement between the model and data was good, there were areas of significant quantitative disagreement. A number of possible reasons for this were discussed, and future model runs were determined to test these hypotheses.

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Refer also to citation(s) 46001, 46633

46364 (AD-A–207876/4/XAB) **Filament eruptions and the impulsive phase of solar flares. Report for 18 May 1987-17 May 1988.** Kahler, S.W.; Moore, R.L.; Kane, S.R.; Zirin, H. Emerson Radio and Phonograph Corp., Jersey City, NJ (USA). 30 Jun 1988. 29p. (SCIENTIFIC–1). Available from NTIS, PC A03/MF A01.

We examine the observed development of filament eruptions in the impulsive phase of flares for evidence of how the eruption is driven. A possibility sometimes adopted as working hypothesis is that the filament eruption and accompanying coronal mass ejection are consequences of energy release in the flare impulsive phase; they are taken to be ejecta in the explosion resulting from the pressure pulse from plasma heating in the flare. Evidence against this view is from four flares in which, in H-alpha movies, a filament eruption was observed during the flare impulsive phase defined by the E = approx. 30 keV hard x-ray emission observed with the U. of Calif. at Berkely detector on the ISEE 3 spacecraft. In each case it was found find that: (1) filament eruption began before onset of the impulsive phase; (2) eruptive motion is consistent with a smooth evolution through the impulsive phase, accelerating, but showing no new acceleration attributable to the impulsive phase; (3) brightening of the H alpha flare ribbons in the impulsive phase occurring in compact areas is much smaller than the overall span of the erupting filament; and (4) the observed projected speed is on the order of 100 km/s at the onset of the impulsive phase. These characteristics indicate that filament eruption is not driven by flare plasma pressure, but instead marks an eruption of magnetic field driven by a global MHD instability of the field configuration in the flare region. It appears that filament eruption and impulsive energy release are coordinated and driven by a common cause, the instability of the whole field configuration. A new mode of energy release, that of the impulsive phase, may be initiated when the eruptive motion surpasses some speed limit of order 100 km/s.

46365 (AD-A–207955/6/XAB) **Detection of CMES (coronal mass ejections) in the interplanetary medium from 1976-1979 using HELIOS-2 photometer data.** Webb, D.F.; Jackson, B.V. Emmanuel Coll., Boston, MA (USA). 28 Aug 1987. 7p. (SCIENTIFIC–2). Available from NTIS, PC A02/MF A01.

Pub. in Proceedings of the International Solar Wind Conference (6th), 267-271(28 Aug 1987).

The use of HELIOS-2 (H2) zodiacal light photometer data to detect solar coronal mass ejections (CMEs) in the interplanetary (IP) medium is described. Data from the north ecliptic pole (+90 deg) photometer are used to identify transient flux increases which are interpreted as plasma clouds of Thomson-scattered electrons enveloping the spacecraft or passing north of it. These data are used to study the characteristics of CMEs in the IP medium during a 4-year period, from 1976 through 1979, covering a gap in coronagraph observations. Most of the WL transients were also detected at the spacecraft as in-situ plasma enhancements, with significant rotation of the IMF and evidence for the passage of magnetic clouds. The extrapolated solar-source regions of the transients were often associated with bright, long-lived coronal regions which define the heliomagnetic equator. Finally, the occurrence rate of IP CMEs increased toward solar maximum, with the 1979 HELIOS and SOLWIND CME rates in basic agreement.

46366 (AD-A–207956/4/XAB) **Observations of coronal mass ejections near the sun.** Kahler, S. Emmanuel Coll., Boston, MA (USA). Physics Research Div. 28 Aug 1987. 19p. (SCIENTIFIC–3). Available from NTIS, PC A03/MF A01.

Pub. in Proceedings of the International Solar Wind Conference (6th) (28 Aug 1987).

The appearance and properties of coronal mass ejections (CMEs) near the sun provide clues for their subsequent development in interplanetary space. Observational results are now available for which most, but not all, of a solar cycle. The statistics concerning angular sizes, latitudes, and occurrence rates were compiled, but significant differences between the Skylab/SMM and SOlwind results remain. The structure of classic loop-like CMEs consists of three parts: the bright loop, a dark void, and a bright core, which correspond to coronal loop, prominence cavity, and prominence, respectively. In a few instances the late stages of CMEs have been interpreted as disconnection events with a pinching off of the magnetic field lines and the formation of a closed structure which moves into the interplanetary. Several lines of evidence now show that CMEs have a significant three-dimensional structure rather than something close to a planar shape. While the sources of cool material in CMEs are readily identified with the erupting prominences, the solar sources of hot material observed in the driver gas to interplanetary shocks are not so obvious. The leading edges of CMEs are frequently preceded by waves or shocks which produce deflections in coronal streamers. The relationship between CMEs and type II burst shocks is unclear, however, since some fast CMEs do not result in type II bursts and some type II bursts are not associated with CMEs.

46367 (AD-A–208151/1/XAB) **Solar-cycle variation of long-duration 10.7-cm and soft x-ray bursts.** Kahler, S.; Cliver, E.W. Emmanuel Coll., Boston, MA (USA). 1988. 13p. (SCIENTIFIC–4). Available from NTIS, PC A03/MF A01.

Pub. in Solar Physics, Vol. 115, 385-396(1988).

Gradual rise-and fall (GRF) microwave bursts and long-duration soft x-ray events (LDEs) are generally accompanied by solar coronal mass ejections (CMEs). Reports from the Ottawa and Penticton stations are used to examine the annual variations from 1965 to 1985 of 10.7-cm GRF bursts with total durations of at least 4 hr. The annual numbers of such bursts are well correlated with the quiet-Sun 10.7-cm flux densities. This result is in contrast with the finding of Koomen et al. (1985) that the annual numbers of > or = 4 hr GOES soft x-ray events are not well correlated with sunspot numbers. We show that the latter result is biased by the large variation of the quiet-Sun x-ray background throughout the solar cycle. Four-hour events are more easily detected in x-ray data than in 10.7-cm data at solar minimum, but, conversely, these events are much more easily detected in 10.7-cm data around solar maximum. About 70% of the most energetic CMEs are associated with > or = 4-hr x-ray or 10.7-cm bursts. A one-to-one relationship does not exist between CMEs and either LDEs or GRF bursts viewed in full-Sun detectors.

46368 (DOE/ER/60590–T1) **Long-term solar-terrestrial observations.** National Research Council, Washington, DC (USA). Panel on Long-Term Observations. 1988. 72p. Sponsored by U.S. DOE Energy Research. DOE Contract AI01-87ER60590. Order Number DE89016318/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

In the fall of 1985, the Committee on Solar-Terrestrial Research (CSTR) created a panel to study the requirements for long-term

monitoring and archiving of solar-terrestrial data. The panel comprised specialists in all four areas that constitute solar-terrestrial science: the sun, interplanetary medium, magnetosphere-thermosphere-ionosphere, and upper atmosphere. It interviewed many individuals from the solar-terrestrial monitoring and data archiving communities, along with administrators and directors from appropriate government agencies. It circulated nearly 500 questionnaires to obtain information and opinions from the broader community to learn which observational data should be considered essential over the long term to support the operational and research needs of solar-terrestrial science. This report summarizes the panel's principal findings, and the panel's recommendations follow. A separate section listing the critical observational needs by area is presented together with the scientific rationale for each area. The recommendations are defended in terms of this explicit scientific rationale and the multifold uses of current and long-term solar-terrestrial observations for continued operational solar-terrestrial forecasts and services. Finally, the panel addresses the question of setting priorities among the critical set of observations during periods of low or declining scientific budgets. Here the most important criterion is the recognition that the field must allocate funding to support new research at the same time that it is acquiring the high-priority data sets over the long term.

46369 (IFT-TM–02/87) **Cosmological model with Einstein - De Sitter metric and closed spatial section.** Wichoski, U.F. Instituto de Fisica Teorica, Sao Paulo, SP (Brazil). Mar 1987. 139p. (In Portuguese). Order Number DE89635901/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

From the hypotesis that our Galaxy, in an early stage of its evolution, was a quasar, our model expects that images of this stage can still be observed in the sky. Thus, we look in a quasar catalogue for the ones that can possibly be interpreted as images of our Galaxy in that stage, with a view to determine the parameters of the model. (author).

46370 (INIS-BR–1559) **Model of a black hole gas submitted to background gravitational field for active galaxy nuclei with application to calculating the continuous emission spectra of massless particles (Photons: neutrinos and gravitons).** Pinto Neto, A. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. 1987. 163p. (In Portuguese). Order Number DE89635902/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

A new theoretical model for active galaxy nuclei which describes the continuous spectrum of rest massless particles (photons, neutrinos and gravitons) in the frequency range from radiofrequency to gamma ray frequency, is presented. The model consists in a black hole gas interacting with a background gravitacional field. The previously models proposed for active galaxy nuclei are exposured. Whole theoretical fundaments based on Einstein general relativity theory for defining and studying singularity properties (black holes) are also presented. (M.C.K.).

46371 (INIS-BR–1572) **Study of primitive universe in the Bianchi IX model.** Matsas, G.E.A. Instituto de Fisica Teorica, Sao Paulo, SP (Brazil). Mar 1988. 114p. (In Portuguese). Order Number DE89635903/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The theory of general relativity is used to study the homogeneous cosmological model Bianch IX with isometry group SO(3) near the cosmological singularity. The Bogoyavlenskii-Novikov formalism to explain the anusual behaviour of the Liapunov exponent associated with this chaotic system, is introduced. (author).

46372 (KEK–88-10, pp. 302-307) **Study of invisible axions in the galaxy.** Inagaki, S. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)); Kobayashi, M.; Shintomi, T.; Ezura, E.; Satoh, I.; Yoshimura, M. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The recent astronomical and astrophysical studies strongly support the existence of non-luminous mass in the universe. As to the constituents of the non-luminous mass, two concepts are opposing: the hot and cold darkmatter. Axions are one of the candidates of the cold dark matter. The present report outlines predicted properties of the galactic axions and the present status of the detection program at KEK. In the program, a cylindrical cavity with 15.0 cm inner diameter is made, which was selected to make full use of the existing 5.2T superconducting solenoid. The TM_{010} mode of the cavity is tunable from 1,53GHz to 1.14GHz using a 2.0 cm diameter sapphire rod. However, there are several stop bands due to unidentifiable parastic modes. The Q-value of the empty cavity at room temperature is 97.6% of the theoretical value. Though it does not look easy to improve the sensitivity by the order of two, the authors persist in the superheterodyne method for rf signal detection. Two FET amplifiers are made to obtain a noise temperature below 10degK with a gain more than 30dB in the region 1.2-1.7GHz. After the amplification of about 60dB at cryogenic temperature, the signal is modulated to 30MHz by an image rejection mixer and amplified another 60dB. Then the IF is converted to 30kHz. By 64 channel filters, the output signal are spectrum-analyzed, sampled by CAMAC modules and stored in optical disks. The data are processed off-line after an appropriate data storage. (N.K.).

46373 (KFKI–1989-21/C) **Analysis of the neutral gas measurements near comet P/Halley based on observations by VEGA-1.** Gringauz, K.I.; Verigin, M.I.; Remizov, A.P.; Oraevskij, A.A.; Richter, A.K.; Szegoe, K.; Varga, A.; Grard, R. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Apr 1989. 46p. Order Number DE89635843/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The in-situ measurements of secondary electrons and sputtered ions caused by impacts of neutral particles on metallic surfaces of the Ram Faraday Cup and Plasma Impact Detector sensors in PLAZMAG-1 instrument aboard VEGA 1,2 spacecraft are used to estimate neutral particle density distribution (n_n) around comet P/Halley up to distances of approximately $3x10^{\sigma}$ km. Asymmetries in n_n distributions along inbound and outbound legs of spacecraft trajectory are attributed to solar radiation pressure. A model calculation, taking into account solar radiation pressure, leads to 'tear drop' shaped distribution of neutral particles around the cometary nucleus. (author) 46 refs.; 11 figs.

46374 (LA-UR–89-2246) **MOXE: An x-ray all-sky monitor for Soviet Spectrum-X-Gamma Mission.** Priedhorsky, W.; Fenimore, E.E.; Moss, C.E.; Kelley, R.L.; Holt, S.S. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8908120–2: SPIE conference on EUV, X-ray, and gamma ray instrumentation for astronomy and atomic physics, 7-11 Aug 1989). Order Number DE89015241/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We are developing a Monitoring X-Ray Equipment (MOXE) for the Soviet Spectrum-X-Gamma Mission. MOXE is an X-ray all-sky monitor based on array of pinhole cameras, to be provided via a collaboration between Goddard Space Flight Center and Los Alamos National Laboratory. Our objectives are to alert other observers on Spectrum-X-Gamma and other platforms of interesting transient activity, and to synoptically monitor the X-ray sky and study long-term changes in X-ray binaries. MOXE will be sensitive to sources as faint as 2 milliCrab (5σ) in 1 day, and cover the 2-20 keV band. 30 refs., 4 figs.

46375 (LA-UR–89-2517) **Inclusion of photon production and transport and (e^+e^-) pair production in a particle-in-cell code for astrophysical applications.** Sulkanen, M.E.; Gisler, G.R. Los Alamos National Lab., NM (USA). 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890931–3: 13. conference on the numerical simulation of plasmas, 17-20 Sep 1989). Order Number DE89015293/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This present study constitutes the first attempt to include, in a particle-in-cell code, the effects of radiation losses, photon production and transport, and charged-particle production by photons scattering in an intense background magnetic field. We discuss the physics and numerical issues that had to be addressed in including these effects in the ISIS code. Then we present a test simulation of the propagation of a pulse of high-energy photons across an intense

magnetic field using this modified version of ISIS. This simulation demonstrates dissipation of the photon pulse with charged-particle production, emission of secondary synchrotron and curvature photons and the concomitant momentum dissipation of the charged particles, and subsequent production of lower-energy pairs. 5 refs.

46376 (LA-UR–89-2825) **Solar opacities constrained by solar neutrinos and solar oscillations.** Cox, A.N. Los Alamos National Lab., NM (USA). 15 Aug 1989. 15p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-890520–1: International conference: inside the sun, 22-26 May 1989). Order Number DE89016988/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This review discusses the current situation for opacities at the solar center, the solar surface, and for the few million kelvin temperatures that occur below the convection zone. The solar center conditions are important because they are crucial for the neutrino production, which continues to be predicted about 4 times that observed. The main extinction effects there are free-free photon absorption in the electric fields of the hydrogen, helium and the CNO atoms, free electron scattering of photons, and the bound-free and bound-bound absorption of photons by iron atoms with two electrons in the 1s bound level. An assumption that the iron is condensed-out below the convection zone, and the opacity in the central regions is thereby reduced, results in about a 25 percent reduction in the central opacity but only a 5 percent reduction at the base of the convection zone. Furthermore, the p-mode solar oscillations are changed with this assumption, and do not fit the observed ones as well as for standard models. A discussion of the large effective opacity reduction by weakly interacting massive particles also results in poor agreement with observed p-mode oscillation frequencies. The much larger opacities for the solar surface layers from the Los Alamos Astrophysical Opacity Library instead of the widely used Cox and Tabor values show small improvements in oscillation frequency predictions, but the largest effect is in the discussion of p-mode stability. Solar oscillation frequencies can serve as an opacity experiment for the temperatures and densities, respectively, of a few million kelvin and between 0.1 and 10 g/cm^3. Current oscillation frequency calculations indicate that possibly the Opacity Library values need an increase of typically 15 percent just at the bottom of the convection zone at 3 x 10^{6}K. 41 refs., 15 figs., 1 tab.

46377 (N–89-16965) **Photoabsorption and photodissociation of molecules important in the interstellar medium. Annual report, 15 January 1988-14 January 1989.** Lee, L.C.; Suto, M. San Diego State Univ., CA (USA). Feb 1989. 54p. (NASA-CR–184771;NAS–1.26:184771). Available from NTIS, PC A04/MF A01.

Photoabsorption and fluorescence cross sections of molecules important in the interstellar medium were measured in the 90 to 200 nm region using synchrotron radiation, excimer laser, and condensed discharge lamps as light sources. The quantitative spectroscopic data are currently needed for the modeling of formation and destruction rates of molecules by the interstellar radiation field. Fluorescences from excited photofragments produced by vacuum ultraviolet radiation of molecules are dispersed to identify the emitting species. The fluorescence data are useful for the identification of emission sources in interstellar clouds.

46378 (N–89-22545) **The shocking development of lithium (and boron) in supernovae.** Dearborn, D.S.P.; Schramm, D.N.; Steigman, G.; Truran, J. Lawrence Livermore National Lab., CA (USA). Feb 1989. 16p. (NASA-CR–183330;NAS–1.26:183330). Available from NTIS, PC A03/MF A01.

It is shown that significant amounts of Li-7 and B-11 are produced in Type 2 supernovae. The synthesis of these rare elements occurs as the supernova shock traverses the base of the hydrogen envelope burning He-3 to masses 7 and 11 via alpha capture. The yields in this process are sufficient to account for the difference in lithium abundance observed between Pop 2 and Pop 1 stars. Since lithium (and boron) would, in this manner, be created in the same stars that produce the bulk of the heavy elements, the lithium abundance even in old Pop 1 stars would be high (as observed). The B-11 production may remedy the long-standing problem of the traditional spallation scenario to account for the observed isotopic ratio of boron. Observational consequences of this mechanism are discussed, including the evolution of lithium and boron isotope ratios in the Galaxy and the possible use of the boron yields to constrain the number of blue progenitor Type 2 supernovae.

46379 (PB–89-139950/XAB) **Solar-Geophysical Data Number 531, November 1988. Part 2 (comprehensive reports). Data for May 1988, and miscellaneous.** Coffey, H.E.; McKinnon, J.A. National Geophysical Data Center, Boulder, CO (USA). Nov 1988. 61p. (SGD–531-PT-2). Available from NTIS, PC A04/MF A01.

See also Part 1, PB–89-139943.

Contents include: detailed index for 1988: data for May 1988 (Meudon carte synoptique, solar flares, solar radio bursts at fixed frequencies, solar x-ray radiation from GOES satellite, mass ejections from the sun, active prominences and filaments).

46380 (UCRL–100710) **Bragg crystal polarimeters.** Silver, E.; Simionivici, A.; Labov, S.; Novick, R.; Kaaret, P.; Martin, C.; Hamilton, T.; Weisskopf, M.; Elsner, R.; Beeman, J.; Chanan, G.; Manzo, G.; Costa, E; Perola, G.; Fraser, G. Lawrence Livermore National Lab., CA (USA). 15 Jun 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890836–5: 33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering, 6-11 Aug 1989). Order Number DE89015775/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A Bragg crystal oriented at 45° to an incoming beam of x-rays acts as a polarization analyzer. This crystal geometry preferentially reflects those x-rays which satisfy the Bragg condition and whose electric vectors are perpendicular to the plane defined by the incident and reflected photons. X-rays with electric vectors parallel to this plane of incidence are photoelectrically absorbed. The energy bandwidth of nearly perfect crystals is extremely small which makes them very inefficient x-ray polarimeters. This limitation is particularly acute for observations of the relatively weak x-ray continuum of stellar sources. The bandwidth can be greatly increased by employing mosaic or ideally imperfect crystals. Mosaic crystals possess a high integrated reflectivity which results in a large increase in the reflection of continuum radiation. A review of the theory and performance characteristics of crystal polarimeters designed for observations of cosmic x-ray sources is presented. 17 refs., 9 figs., 4 tabs.

46381 (UCRL–100983) **Equation-of-state data of synthetic uranus.** Nellis, W.J.; Mitchell, A.C. Lawrence Livermore National Lab., CA (USA). Jun 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890798–8: AIRAPT and EHPRG international high pressure science and technology conference, 17-21 Jul 1989). Order Number DE89016509/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

New equation-of-state data for the liquid mixture we call synthetic Uranus is discussed. This liquid was double-shocked to 220 GPa and 3 g/cm^3. These data are coincident with the adiabat of Uranus calculated by Hubbard and Marley. 7 refs.

6402 Atmospheric Physics

Refer also to citation(s) 46047, 46663, 46664

46382 (AD-A–208083/6/XAB) **Monostatic observation of the F-region structure. Professional paper.** Paul, A.K. Naval Ocean Systems Center, San Diego, CA (USA). Aug 1988. 6p. Available from NTIS, PC A02/MF A01.

Pub. in Radio Science, Vol. 23, No. 4, 580-584(Jul-Aug 1988).

F-region parameters can change by relatively large amounts over short periods of time (fraction of an hour) under so-called undisturbed conditions. There is evidence that these changes are due to propagating acoustic gravity waves. While the periods of these variations and other local parameters (Doppler velocity and angle of arrival) can be measured with a high-resolution digital ionosonde, other quantities like wavelength or magnitude and direction of the propagation velocity cannot be observed. The Clarke Lake radio astronomical antenna array which can be operated in the HP band allows tracking the motion of medium-scale (100-500 km) disturbances by observation of the changes in the apparent position of radio stars. Some first data samples were recorded and analyzed.

46383 (AD-A-208187/5/XAB) **Medium-scale structure of the F-region.** Paul, A.K. Naval Ocean Systems Center, San Diego, CA (USA). Mar 1989. 23p. Available from NTIS, PC A03/MF A01.

Data collected during 1980/81 at Brighton, Colorado, show clearly that the F-region variations are undersampled in space and time by standard recording procedures. Fast temporal changes, with periods as short as 10 minutes, are directly observable if ionograms are taken in rapid sequences of a least 12 ionograms per hour. In order to obtain a correct spatial sampling, the distances between observing stations should not be much larger than 100 kilometers. This conclusion is derived from the temporal variations of F-layer parameters assuming a propagation velocity typical for acoustic gravity waves. Some direct estimates of a spatial structure scale can be obtained from angle of arrival measurements. Comparisons of foF2 and MUF(3000) indicate that the main effect of gravity waves on the F-region structure is the variation of the height of the layer and to a lesser degree a variation of the maximum electron density.

46384 (IC-89/33) **Modelling of the effects of the equatorial electrojet on its environment.** Bestman, A.R. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 20p. Order Number DE89636298/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The effect of the equatorial electrojet on the velocity vector and the temperature of the surrounding environment is modelled by the classical magnetohydrodynamic equations. Under the assumption of small hydrodynamic and magnetic Reynolds numbers and an electrojet magnetic field which oscillates along its axis, z, the nonlinear governing equations are solved by asymptotic approximation. The effect of the intensity of the magnetic field, inter alia, on the flow variables are deduced quantitatively. For example, when the field intensity is small, the temperature distribution is large and vice versa. Also at the higher approximation, there is a component of the flow variables which is completely independent of the axis, z, of the magnetic field variation. Since the classical equation for the temperature is quite similar to the mass diffusion equation, the present study also sheds light on the effect of the electrojet on the atmospheric ozone in its vicinity. Indeed the thermal field and the ozone concentration are affected similarly. (author). 17 refs, 2 figs.

46385 (INPE-3849) **Study on plasmaspheric electric fields and theirs influences on charged particle dynamics.** Mendes Junior, O. Instituto de Pesquisas Espaciais, Sao Jose dos Campos, SP (Brazil). Apr 1986. 132p. (In Portuguese). Order Number DE89636299/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

An analysis of plasmaspheric electric field measurements obtained by the S3-3 satellite in 1976-77, at L approx. 2 an during periods of intense geomagnetic activity, is presented. It is concluded that these measurements must have contributions both of the penetration electric field, associated with convection at the outer magnetosphere, as well as of the fields due to the 'disturbed' ionospheric dynamo. A study of the dynamics of electrons (within 10^{-1} to 10^{2} KeV) and protons (within 10^{-1} to 10^{2} KeV) inside the plasmasphere is also presented. It is concluded that, during quiet geomagnetic periods, electrons tend to corrotate with the Earth and simultaneously drift away from it. On the other hand, protons show a more complex dynamical behaviour, strongly depending on energy and on local time; presenting open orbits, similar to those of the electrons, except for an energy range in which closed orbits exist within determinate intervals of local time. During magnetically disturbed periods, the behaviour of electrons and protons remain approximately unaltered, although the energy intervals for which the open and closed orbits of protons occur get shifted. (author).

6403 Atomic, Molecular, and Chemical Physics

Refer also to citation(s) 45570, 45824, 45833, 45934, 45994, 46610, 46611, 46612, 46672, 46691

46386 (AD-A-207663/6/XAB) **Differential cross sections for secondary electron production by 1.5-keV electrons in water vapor.** Hollman, K.W.; Kerby, G.W.; Rudd, M.E.; Miller, J.H.; Manson, S.T. Georgia State Univ., Atlanta, GA (USA). Dept. of Physics. 1 Oct 1988. 5p. Available from NTIS, PC A02/MF A01.

Pub. in Physical Review A, Vol. 38, No. 7, 3299-3302(1 Oct 1988).

Discrepancies between previous experimental values of differential cross sections for electron-impact ionization of water vapor and recent model calculations have been largely resolved. A new measurement with improved suppression of spurious electrons has removed most of the discrepancy in the midrange of detected electron energies. A second discrepancy at secondary energies just below the primary energy has been explained by a more accurate accounting for electrons scattered at angles between zero and the minimum angle of the experimental apparatus. The improved data show more clearly the oxygen K-shell edge in the spectra at small angles and the Bethe ridge at angles up to 90 deg. The forward peak seen in the earlier data is no longer present.

46387 (AD-A-207846/7/XAB) **Hydrogen adsorption at Nb(100): Photoemission evidence of two-stage exchange involving subsurface states.** Fang, B.S.; Ballentine, C.A.; Erskine, J.L. Texas Univ., Austin, TX (USA). Dept. of Physics. 1988. 9p. Available from NTIS, PC A02/MF A01.

Pub. in Surface Science Letters, Vol. 204, L713-L720(1988).

Temperature-dependent properties of electronic states resulting from hydrogen adsorption of Nb(100) surfaces were studied by photoemission spectroscopy using synchrotron radiation. The most prominent hydrogen-induced feature in photoemission spectra exhibits a temperature dependence that requires contributions from two distinct states. Analysis of the photon energy-dependent cross section of the hydrogen-induced features suggests that hydrogen chemisorption sites are located below the surface. These results have important consequences for kinetic models that attempt to account for hydrogen uptake by Nb.

46388 (CONF-890829-1) **Production and stability of S_2F_{10} in SF_6 corona discharges.** Sauers, I.; Siddagangappa, M.C.; Harman, G.; Van Brunt, R.J.; Herron, J.T. Oak Ridge National Lab., TN (USA). 1989. 4p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 6. international symposium on high voltage engineering (ISHVE-6); 28 Aug - 1 sep 1989. Order Number DE89016851/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report the yield of S_2F_{10} produced in corona discharges in SF_6 and the dependence of the S_2F_{10} yield on various parameters. The data were obtained from two experimental systems, both employing point-to-plane geometry: (1) a small corona cell (200-ml in volume) with a gas chromatograph-thermal conductivity analyzer (GC-TCD) at ORNL and (2) a large corona cell with a gas chromatograph-mass spectrometer (GC-MS) analyzer at NIST (formerly NBS). The GC-MS technique was found to be quite sensitive to S_2F_{10} when the mass analyzer was turned to mass 86 (SOF_2^+). The mechanism for conversion of S_2F_{10} into SOF_2 at the end of the GC column is not yet understood. In both experiments, the concentration of S_2F_{10} increased linearly with time. However, the charge rate-of-production appeared to depend on uncontrollable factors such as moisture content. Although the thermal decay of S_2F_{10} is predicted to be very slow (10^7 year half-life at 23°C), surface processes may account for an increase in the S_2F_{10} decomposition rate. 13 refs., 6 figs., 2 tabs.

46389 (CONF-890829-2) **Influence of water vapor and decomposition products on the positive- and negative-ion spectra of SF_6 corona.** Sauers, I.; Siddagangappa, M.C.; Harman, G. Oak Ridge National Lab., TN (USA). [1989]. 4p. Sponsored by U.S. DOE Conservation & Renewable Energy. DOE Contract AC05-84OR21400. From 6. international symposium on high voltage engineering (ISHVE-6); 28 Aug - 1 sep 1989. Order Number DE89016879/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We report on the positive- and negative-ion spectra obtained from in-situ mass spectrometric analyses of ions sampled from corona discharges in SF_6 at P = 6.7 kPa (50 Torr). In positive-ion spectra the presence of water vapor results in the formation of water cluster ions of the form $H^+(H_2O)_n$. The distribution of cluster sizes shifts to smaller clusters as the water vapor content decreases. In addition to the SF_6 fragment ions (SF_5^+, SF_3^+, and SF_2^+), which are observed under relatively dry conditions, the hydrated species $SF_5^+(H_2O)$ is observed down to water additions of only 40 ppM, the

lowest concentration studied. In addition, the ion detected at mass 197 is believed to be the complex $SF_3^+(SF_4)$ where SF_4 is an important neutral by-product of SF_6 discharges. In negative-ion spectra, the influence of water vapor is manifested indirectly by the formation of HF clusters of the form $F^-(HF)_n$. Other clustered species observed include $OH^-(H_2O)_n$ and $OH^-(HF)_n$. The role of other decomposition by-products, such as SOF_4 and SO_2, of SF_6 corona on the positive- and negative-ion spectra will also be discussed. 11 refs., 6 figs., 1 tab.

46390 The stark effect in atoms at extremely high intensities: Ponderomotive potentials and all that. Freeman, R.R. (AT & T Bell Laboratories, Murray Hill, NJ (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Recent measurements of the kinetic energies of photoelectrons produced in multiphoton ionization of the rare gases for ultra-short ($\leq$ 250 femtosec), high intensity ($\approx 10^{14}$W/cm^2) light near 616 nm reveals a complex spectra, rich in structure with some features so narrow in energy that they are limited by the spectrometer resolution. In this paper the author shows that this thoroughly unanticipated result is a signature of a general phenomena, one that is present (but often hidden) in all multiphoton experiments regardless of the pulse length employed in the particular experiment. Further, he argues this phenomena is directly related to the ponderomotive potential associated with the wiggle motion that an electron executes under the influence of an intense optical field. 12 refs., 4 figs.

46391 Search for x-rays generated by collisionless multiphoton processes. Lee, P.H.Y. (Los Alamos National Lab., NM (USA)); Casperson, D.E.; Schappert, G.T. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract W-7405-ENG-36. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors have conducted photon counting experiments to search for x-rays which may be generated by either collisionless multiphoton induced inner-shell processes or bremsstrahlung at high laser irradiance. Using KrF light at an irradiance $\sim 3 \times 10^{17}$ W/cm^2 on low density Xe gas targets, they detect no prompt photons which are characteristic of these processes.

46392 Investigations of multiphoton excitation and ionization in a short range potential. Susskind, S.M. (Princeton Univ., NJ (USA)); Cowley, S.C.; Valeo, E.J. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract AC02-76CH03073. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors introduce an approach to the study of excitation and ionization for a system containing a model confining potential consisting of a set of δ-functions. In particular, analytical and numerical results are presented for the multiphoton ionization rate, under strong field conditions, of an electron confined by a δ-function potential. 10 refs., 3 figs.

46393 Multiphoton spectroscopy of multielectron atoms and the quest for direct two-electron ejection. Lambropoulos, P. (Univ. of Southern California, Los Angeles (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The author presents a brief review of recent high intensity experiments showing the participation of multiphoton resonances with bound atomic states. The results compare favorably with some of our calculations on rare gases and alkaline earths. 11 refs.

46394 Symmetries and asymmetries in above-threshold ionization. Bucksbaum, P.H. (AT & T Bell Laboratories, Murray Hill, NJ (USA)); Bashkansky, M.; Schumacher, D.W. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Angular distributions of atomic-electrons photoionized above threshold by intense elliptically polarized light contain strong asymmetries with respect to reflection about either principal polarization axis. These observations, which contradict Keldysh-Faisal-Geiss theory predictions, point to the significant role of the long range electrostatic potential of the ion in shaping the wave function of the outgoing electron. The experimental evidence for this phenomenon is reviewed for helium, krypton, and xenon photoelectron spectra, as a function of laser intensity, polarization, and electron energy. 15 refs., 10 figs.

46395 Multiphoton ionization with femtosecond laser pulses. Muller, H.G. (Centre Etudes Nucleaire Saclay, Gif-sur-Yvette (France)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

There are a number of reasons to use subpicosecond pulses in multiphoton ionization experiments. Pulses with shorter risetimes make it possible to study processes with higher rates before one runs into the problem of depletion of target atoms. Furthermore, the momentum of the electron does not change between the point of ionization and the detector if the pulse expires before the electron has time to sample the spatial inhomogeneity of the light intensity. This makes it possible to identify the intensity at which an electron was formed from the energy with which it reaches the detector. Yet another advantage is the fact that the primary ionization products are subject to the ionizing radiation for only a short amount of time, thus reducing the probability of sequential ionization as compared to direct processes. In this paper the experimental results on the multiphoton ionization of xenon with pulses of 100 fs, that were obtained during the preceding year at ENSTA, Palaiseau, will be presented.

46396 High-order harmonics in light scattering by atomic electrons above threshold. Eberly, J.H. (Univ. of Rochester, NY (USA)); Su, Q.; Javanainen, J. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors report on light scattering in multiphoton ionization (MPI) computer experiments at high laser intensity. The plateau and cut-off features recently reported in laboratory experiments on high-order harmonic generation by McPherson, et al., and by Ferray, et al., are corroborated. They report scattered light spectra in four different cases and exhibit the corresponding ATI photoelectron spectra. They propose a connection between ATI and high-order harmonics. 7 refs., 5 figs.

46397 Parabolic mirror electron energy analyzer for multiphoton photoemission spectroscopy. Van Woerkom, L.D. (AT & T Bell Laboratories, Murray Hill, NJ (USA)); Trevor, D.J.; Freeman, R.R. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors report the use of a new, extremely efficient electron energy analyzer for recording high resolution electron spectra from multiphoton photoemission. The analyzer used an electrostatic parabolic mirror and has a collection solid angle in excess of 2π sr with an energy resolution of 35 meV at 1.8 eV. They have used this detector to record the above threshold ionization spectra emitted in xenon using a 275 fsec, 616 nm, 2×10^{14} W/cm^2 laser pulse. 5 refs., 4 figs.

46398 Vacuum ultraviolet laser spectroscopy of molecular autoionizing states. Milburn, D. (Univ. of Waterloo, Ontario (Canada)); Hart, D.J.; Hepburn, J.W. pp. 436 of Short wavelength

coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

This paper describes a new apparatus which uses coherent vacuum ultraviolet light to photoionize molecules in a supersonic molecular beam, and energy analyzes the resulting photoelectrons by time of flight spectroscopy. The broadly tunable coherent VUV is generated by four wave sum mixing in Hg. Using this apparatus, the authors have studied the dynamics of autoionization for two different systems: spin-orbit autoionization in HI, and vibrational autoionization in NO. In both cases, our recent results have pointed out dramatic new features of the dynamics in these molecules. 24 refs., 9 figs.

46399 Measurement of the quenching of spontaneous emission coefficients in laser-produced plasmas. Chung, Y. (Princeton Univ., NJ (USA)); Hirose, H.; Suckewer, S. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The quenching of Einstein A-coefficients was observed by measuring the branching ratio of visible and VUV line intensities for CIV, CIII, and NV ions. 16 refs., 11 figs., 1 tab.

46400 Ultra-high resolution VUV-XUV laser: Application to the hyperfine study of krypton. Kung, A.H. (Lawrence Berkeley Lab., CA (USA)); Trickl, T.; Cromwell, E.; Vrakking, M.J.J.; Lee, Y.T. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). DOE Contract AC03-76SF00098. From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A near-transform-limited VUV-XUV laser source with 210 MHz resolution has been constructed and used to study the hyperfine splitting, isotope shift, and lifetime of the three lowest ns (n=5,6,7) Rydberg states of Krypton. 6 refs., 1 tab.

46401 All short pulse multiphoton ionization is resonant ionization. Cooke, W.; Freeman, R.R.; McIlrath, T.J. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Energy resolved photoelectron spectra of multiphoton ionization taken with a 300 fs laser pulse at 616 nm shows that the ionization probability is highly structured as a function of laser intensity. The spectrum is consistent with all of the ionization occurring at intensity resonances.

46402 (GSI–89-49(prepr.)) **Correlated electron-positron emission in heavy-ion collisions.** Bokemeyer, H.; Folger, H.; Backe, H.; Bethge, K.; Kraft, D.; Sakaguchi, K.; Salabura, P.; Stiebing, K.E.; Cowan, T.; Greenberg, J.S.; EPOS Collaboration. EPOS Collaboration. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 16p. (CONF-890199–: 8. Moriond workshop on tests of fundamental laws in physics, 21-28 Jan 1989). Order Number DE89915142/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A group of narrow electron-positron sum-energy lines with similar mean energies around 610, 750 and 810 keV has been observed with the EPOS spectrometer in both collision systems $^{238}U + ^{232}Th$ and $^{238}U + ^{181}Ta$ studied so far at the UNILAC heavy ion accelerator of GSI, Darmstadt. The intensities of the three lines vary with the beam-energy, the variation being most clearly observed for the 748-keV line in $^{238}U + ^{181}Ta$. On the basis of our present understanding Internal Pair Conversion in a collision product at rest or in flight as well as coincident lepton emission during the quasiatomic phase of the collision can be excluded as the origin. The very narrow widths of the sum-energy lines as compared to the widths of the associated broad structure in the difference spectrum of the lepton energies seem to argue for a mutual cancellation of kinematical shifts. Such correlation is expected for two leptons emitted back-to-back in a two-body decay of objects being at rest in the heavy-ion c.m. frame. This speculative hypothesis is confronted with the actual dependence of the lines on the individual lepton energy and the lepton emission angle, as well as on the opening angle of the pair. In fact, the back-to-back decay could not be proved to be a general feature of these lines. (orig.).

46403 (INIS-BR–1584) **Study of internal rotation in molecules using molecular orbital method in the CNDO/BW approximation.** Pedrosa, M.S. Brasilia Univ., DF (Brazil). Dept. de Fisica. Oct 1987. 90p. (In Portuguese). Order Number DE89635737/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

It is presented a LCAO-MO-SCF study of Internal Rotation for the molecules C_2H_6, CH_3NH_2, H_2O_2, and N_2H_4 by ysing the CNDO/BW approximation and an M-center energy partition. Our results are compared with those obtained with the CNDO/2 approximation. It is shown that there are differences in the analysis of the process involved in the internal rotation barriers mechanism. Thus the interpretation of the results is strongly dependent on the parametrization used. (author).

46404 (INIS-BR–1593) **Theoretical studies on CH^+ ion molecule using configuration interaction method and its spectroscopic properties.** Machado, F.B.C. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1985. 146p. (In Portuguese). Order Number DE89635736/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The use of the configuration (CI) method for the calculation of very accurate potential energy curves and dipole moment functions, and then their use in the comprehension of spectroscopic properties of diatomic molecules is presented. The spectroscopic properties of CH^+ and CD^+ such as: vibrational levels, spectroscopic constants, averaged dipole moments for all vibrational levels, radiative transition probabilities for emission and absorption, and radiative lifetimes are verificated. (M.J.C.).

46405 (INIS-BR–1601) **Studies on eletron scattering by hydrogen atoms through of a correlationed wave function.** Jacchieri, S.G. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1982. 83p. (In Portuguese). Order Number DE89635742/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

A correlationed wave function dependent of two adjustable parameters (α e β), aiming describe a system formed by an electron and a hydrogen atom is studied. Some elastic differential cross-sections for several values of α and β parameters, scattering angle of 2^0 to 140^0 and energies of 50 eV and 680 eV are presented. (M.J.C.).

46406 (INIS-BR–1602) **Deuterium NMR, induced and intrinsic cholesteric lyomesophases.** Alcantara, M.R. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1982. 164p. (In Portuguese). Order Number DE89635738/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

Induced and intrinsic cholesteric lyotropic mesophases were studied. Induced cholesteric lyomesophases based on potassium laurate (KL) system, with small amounts of cholesterol added, were studied by deuterium NMR and by polarizing microscopy. Order profiles obtained from deuterium NMR of KL perdenderated chains in both induced cholesteric and normal mesophases were compared. The intrinsic cholesteric lyotropic mesophases were based on the amphiphile potassium N-lauroyl serinate (KLNS) in the resolved levo form. The study of the type I intrinsic cholesteric mesophase was made by optical microscopy under polarized light and the type II intrinsic cholesteric lyomesophase was characterized by deuterium NMR. The new texture was explained by the use of the theory of disclinations developed for thermotropic liquid crystals, specially for cholesteric type. (M.J.C.).

46407 (LA-UR–89-2446) **Quantum-mechanical derivation of the Davydov equations for multi-quanta states.** Kerr, W.C.; Lomdahl, P.S. Los Alamos National Lab., NM (USA). [1989]. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8908122–1: NATO workshop on localization of energy in proteins, 1-5 Aug 1989). Order Number

DE89015250/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Our purpose here is to present a derivation of the Davydov equations which employs only quantum-mechanical techniques. The derivation here is more general than our previous treatment of this problem because we use an Ansatz which has present several quanta of the high frequency oscillator system rather than just one quantum. Since some steps of the calculation are the same as those in our paper which treats the single quantum case, reference will be made to that paper for some of the those details. 9 refs.

46408 (LA-UR–89-2453) **Davydov solutions at 300 kelvin: The final search.** Lomdahl, P.S.; Kerr, W.C. Los Alamos National Lab., NM (USA). [1989]. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8908122–2: NATO workshop on localization of energy in proteins, 1-5 Aug 1989). Order Number DE89015248/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The original proposal by Professor A.S. Davydov of a soliton mechanism for localization and transport of energy along linear chain molecules provided the impetus for several research efforts which have explored the properties of these nonlinear entities in differing degrees of realism. The general conclusion from all of this work is that the nonlinear equations of motion which have been used to describe these systems have soliton-like solutions when they are solved in the deterministic limit. This limit corresponds to the absolute zero of temperature, because it ignores the influence of random thermal perturbations on the system. However, the questions of existence and importance of the Davydov soliton remain controversial when non-zero temperature effects are taken into account, because numerical simulations and theoretical calculations done by independent research groups have reached diametrically opposed conclusions. Our 1985 paper was the first to simulate thermal perturbations at biologically relevant temperature (300 K). Since publishing that paper, we have done simulations for collisions of phonon wave packets with Davydov solitons and have also taken into account the presence of multiple quanta of the high frequency oscillator field in the Davydov equations of motion. We present these results here. However, for the major question about the temperature effects on the Davydov soliton, our conclusions remain unchanged. 5 refs., 6 figs., 1 tab.

46409 (LA-UR–89-2724) **The effects of a finite scattering volume on the determination of electron impact coherence parameters.** Zetner, P.W.; Trajmar, S.; Csanak, G. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by DOE/MA;NASA;NSF. DOE Contract W-7405-ENG-36. (CONF-890895–2: Polarization and correlation in electronic and atomic collisions, 2-4 Aug 1989). Order Number DE89016588/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In this paper, we specifically examine the consequences of a finite scattering geometry on "in-plane" coherence experiments, i.e. polarization correlation or superelastic scattering experiments in which the incidence vector of the detected photon or the laser 'photon lies in the nominal scattering plane ($\phi\nu$ = 0). The "in-plane" experimental configuration is adopted in order to give direct information about spin-orbit coupling effects. We show that a finite scattering geometry can give rise to severe distortion in the dependence of the coincidence or superelastic scattering signal intensity on the photon polarization and that this distorted behavior can be misinterpreted as arising from spin-orbit coupling effects. 11 refs., 3 figs.

46410 (LA-UR–89-2798) **Structure and properties of simple molecular systems at very high density.** LeSar, R. Los Alamos National Lab., NM (USA). [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890798–10: AIRAPT and EHPRG international high pressure science and technology conference, 17-21 Jul 1989). Order Number DE89016974/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The use of computer simulations in the study of molecular systems at very high density is reviewed. Applications to the thermodynamics of dense fluid nitrogen and phase transitions in solid oxygen are presented. The effects of changes in the atomic electronic structure on the equation of state of very dense helium are discussed. 19 refs., 2 figs.

46411 (ORNL/FTR–3064) **[Production of highly charged Ions, Grenoble, France, Uppsala, Sweden, Stockholm, Sweden, Berlin, FRG, Osnabrueck, FRG, Giessen, FRG, Frankfurt, Germany, September 10, 1988–October 2, 1988]: Foreign trip report.** Meyer, F.W. Oak Ridge National Lab., TN (USA). 18 Oct 1988. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017275/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler attended the International Conference on the Physics and Production of Highly Charged Ions in Grenoble, France, and presented an invited paper on the multicharged ion-surface scattering work done at ORNL. Following this meeting he traveled to Sweden, where he visited Uppsala University to consult on the design and layout of atomic physics beam lines originating from an ECR ion source that will soon be installed there. He also visited the Research Institute of Physics at Stockholm to tour the CRYRING facility. The traveler subsequently visited Hahn-Meitner Institute, Berlin, and Osnabrueck University, Osnabrueck, both in West Germany, to present seminars and to hold discussions on collaborative work in multicharged ion-atom and -surface collision experiments, respectively. Finally, the traveler visited Justus-Liebig University in Giessen, West Germany, to view the ECR source facility there, and to discuss future multicharged ion collision experiments of mutual interest.

46412 (ORNL/FTR–3253) **[Perform quantum chemistry calculations on element 104 using existing computer programs]: Foreign trip report, June 1, 1988–May 10, 1989.** Johnson, E. Oak Ridge National Lab., TN (USA). 26 May 1989. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017293/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Electron ionization energies and parameters for the atomic radii of elements 104 and 105 are discussed. Values for these properties have not been proposed before. The results are expected to provide part of the basis for the calculation of certain chemical properties of elements 104 and 105. Chemical properties of elements 104 and 105 are difficult to determine experimentally because of the short half-lives and low production rates of these elements. A fully numerical method for the solution of the Schrodinger equation of quantum mechanics is discussed. Fully numerical methods are capable of yielding more accurate results than the method that was used to obtain the ionization energies mentioned above. Compared to other fully numerical methods, the method discussed here requires less computation time and it does not have the mathematical singularities that occur in other such methods. Energy research and development projects at the Gesamthochschule Kassel, Federal Republic of Germany are summarized. These projects involve consultation, wind and solar energy production, storage and distribution, hydroelectricity production, the production of biogas, the design of fuel cells, technology transfer, and the political aspects of energy production and distribution. 12 refs.

46413 Search for multiphoton-induced inner-shell excitations. Lee, P. H. Y. (Los Alamos National Laboratory, Mail Stop E-526, Los Alamos, New Mexico 87545(US)); Casperson, D. E.; Schappert, G. T. *Physical Review [Section] A: General Physics (USA)*, 40(3): 1363-1366 (1 Aug 1989). DOE Contract W-7405-ENG-36.

Photon-counting experiments have been conducted to test the conjecture that at sufficiently high laser irradiance, atomic inner-shell excitations can be induced by laser-driven outer-shell oscillations. Using KrF light at an irradiance $\approx 3\times10^{17}$ W/cm^2 on low-density noble-gas targets, we detect no prompt photons which are characteristic of inner-shell processes.

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Refer also to citation(s) 45886, 46671

46414 (AD-A–207716/2/XAB) **Multicomponent e-beam resists containing organometallic compounds and reactive monomers. Technical report.** Namaste, Y.M.; Dems, B.C.; Malhotra, S.; Vane, L.M.; Obendorf, S.K. Cornell Univ., Ithaca, NY (USA).

School of Chemical Engineering. 12 May 1989. 14p. (TR–11). Available from NTIS, PC A03/MF A01.

Negative working resists with combined e beam sensitivity and oxygen etch resistance have been formulated by combining a host polymer for dimensional stability during radiation processing, an unsaturated, non-volatile monomeric component for control of sensitivity, and, an organometallic compound to contribute (Reaction ion etching) RIE resistance in an oxygen plasma. We have incorporated these three components into blends by three methods. Microlithography, Electron beam resist, Organometallic compounds, Reactive ion etching. (MJM)

46415 (AD-A–207980/4/XAB) **Studies of the volume and plasma-sheath properties of radio-frequency discharges. Final report, 1 June 1983-28 February 1987.** Ernie, D.W.; Oskam, H.J. Minnesota Univ., Minneapolis, MN (USA). Dept. of Electrical Engineering. Nov 1988. 109p. Available from NTIS, PC A06/MF A01.

Radio-frequency discharges currently play a major role in the fabrication of microelectronic devices. This manuscript reports on theoretical and experimental studies undertaken in an effort to develop a better understanding of the underlying gas-discharge physics occuring in these discharges. An equivalent circuit model was developed for a planar rf reactor based on the physical properties of the plasma sheath. This model shows that the waveforms of the potentials across the plasma sheaths are highly nonlinear and agree with previously reported measurements. These waveforms were subsequently incorporated into a model for the energy distribution of ions bombarding the electrode surfaces in low pressure rf reactors. Numerical calculations based on this model show the ion bombardment energy distribution is bimodal and skewed toward lower impact energies. Experimental measurements were also performed on the ion-bombardment energy distribution in a planar rf reactor. The results of these measurements agree with the model predictions at low pressure and give information at higher pressures about the effects of collisions on the distribution, which agree with previous studies. The importance of negative ions in a discharge through an electronegative gas was investigated by the development of a collisionless-plasma sheath model for such a discharge. A sheath criterion was derived and used to determine the effects of negative ions on the sheath properties.

46416 (CONF-8908112–2) **An experimental study of helicity and related properties in turbulent flows.** Wallace, J.M.; Balint, J.L. Maryland Univ., College Park, MD (USA). 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13838. From IUTAM symposium on topological fluid mechanics; Aug 1989. Order Number DE89016785/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses the measurement of the velocity and vorticity vectors in turbulent flow and the experimental results. 20 refs., 4 figs. (LSP)

46417 (DOE/ER/13902–1) **Thermophysical properties of supercritical fluids and fluid mixtures: Progress report, May 15, 1988–July 31, 1989.** Sengers, J.V. Maryland Univ., College Park, MD (USA). Inst. for Physical Science and Technology. Aug 1989. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER13902. Order Number DE89016568/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The purpose of the research is to extend the theory of critical phenomena in fluids and fluid mixtures to obtain scientifically based equations that include the crossover from the asymptotic singular behavior of the thermophysical properties close to the critical point to the regular behavior of these properties far away from the critical point.

46418 (LA-UR–89-2429) **A parallel numerical simulation for supersonic flows using zonal overlapped grids and local time steps for common and distributed memory multiprocessors.** Patel, N.R.; Sturek, W.B.; Hiromoto, R. Los Alamos National Lab., NM (USA). 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-890941–1: Conference on applications of supercomputers in engineering, 5-7 Sep 1989). Order Number DE89015252/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Parallel Navier-Stokes codes are developed to solve both two- dimensional and three-dimensional flow fields in and around ramjet and nose tip configurations. A multi-zone overlapped grid technique is used to extend an explicit finite-difference method to more complicated geometries. Parallel implementations are developed for execution on both distributed and common-memory multiprocessor architectures. For the steady-state solutions, the use of the local time-step method has the inherent advantage of reducing the communications overhead commonly incurred by parallel implementations. Computational results of the codes are given for a series of test problems. The parallel partitioning of computational zones is also discussed. 5 refs., 18 figs.

46419 (LA-UR–89-2800) **The Riemann problem for a model non-linear elastic continuum.** Hammerberg, J.E. Los Alamos National Lab., NM (USA). [1989]. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–27: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016973/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The solution to the Riemann problem for a non-linear elastic continuum characterized by an internal energy density $e(S, \epsilon_{ij})$, where S is the entropy and ϵ_{ij} the strain tensor, is discussed. Numerical solutions for the wave structure for parameters appropriate to Tungsten are discussed. 4 refs.

46420 (LNCC–035/88) **Existence of Bose-Einstein condensation in one and two dimensions.** Olinto, A.C. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Oct 1988. 14p. Order Number DE89635910/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

It is shown that in Bose Condensed systems the γ-sum rule has an additional term due to the condensate reservoir. As a result of this new sum rule and an exact Bogoliubov inequality, Bose-Einstein condensation in repulsively interacting systems may occur in one and two dimensions. (author).

46421 (N–89-22709) **High accuracy thermal conductivity measurements near the lambda transition of helium with very high temperature resolution. Final report.** Fairbank, W.M.; Lipa, J.A. Stanford Univ., CA (USA). Mar 1989. 26p. (NASA-CR–184836;NAS–1.26:184836). Available from NTIS, PC A03/MF A01.

Over the past few years extensive thermal conductivity measurements near the lambda point of helium were made. The original goal of measuring the thermal conductivity with a resolution of t = T/T sub lambda -1 of 3 x 10(-8) was reached, but with somewhat less accuracy than was hoped. Subtle effects in the apparatus near the transition were observed which reduced the ability to interpret the results. Nevertheless, for resolution of t is greater than or equal to 10(-7) reliable data was obtained, extending previous measurements by more than an order of magnitude. Deviations from theoretical predictions were observed for t is less than or equal to 3 x 10(-6) leading to the question of the validity of the present renormalization group analysis of transport properties, at least for the case of helium. This anomaly led to closer examination of the boundary effects in the measurements. During the experiments a totally unexpected effect in the very dilute He-3 - He-4 mixtures was observed which led to the explanation of the anomalous results. The concentration dependence of the thermal conductivity near T sub lambda in the superfluid phase was found to deviate strongly from the predictions. The results gave an independent verification of this behavior and caused reanalysis of the Khalatnikov theory of hydrodynamics of the mixtures. An alternative solution was found which is in better agreement with the experiment.

46422 (UCRL–101562) **Cellular automata and massively pararllel physics.** Leith, C.E. Lawrence Livermore National Lab., CA (USA). Mar 1989. 4p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8903159–1: Whither turbulence conference, 22-24 Mar 1989). Order Number DE89016506/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper discuss using cellular automata and parallel processing for computer simulation of fluid dynamics. 12 refs. (LSP)

46423 A comparison between integral equation theory and molecular dynamics simulations of dense, flexible polymer liquids. Curro, J. G. (Sandia National Laboratories, Albuquerque, New Mexico(US)); Schweizer, K. S.; Grest, G. S.; Kremer, K. *Journal of Chemical Physics (USA)*, 91(2): 1357-1364 (15 Jul 1989). DOE Contract AC04-76DP00789.

Recently we (J.G.C. and K.S.S.) formulated a tractable "reference interaction site model" (RISM) integral equation theory of flexible polymer liquids. The purpose of this paper is to compare the results of the theory with recent molecular dynamics simulations (G.S.G. and K.K.) on dense chain liquids of degree of polymerization N=50 and 200. Specific comparisons were made between theory and simulation for the intramolecular structure factor $\hat{\omega}(k)$ and the intermolecular radial distribution function $g(r)$ in the liquid. In particular it was possible to independently test the assumptions inherent in the RISM theory and the additional ideality approximation that was made in the initial application of the theory. This comparison was accomplished by calculating the intermolecular $g(r)$ using the simulated intramolecular structure factor, as well as, $\hat{\omega}(k)$ derived from a freely jointed chain model.The RISM theory results, using the simulated $\hat{\omega}(k)$, were found to be in excellent agreement, over all length scales, with the $g(r)$ from molecular dynamics simulations. The theoretical predictions using the "ideal" intramolecular structure factor tended to underestimate $g(r)$ near contact, indicating local intramolecular expansion of the chains. This local expansion can be incorporated into the theory self consistently by including the effects of the "medium induced" potential on the intramolecular structure.

46424 Velocity persistence of Brownian particles generated in a glow discharge. Hurd, A. J. (Sandia National Laboratories, Albuquerque, New Mexico 87185(US)); Ho, P. *Physical Review Letters (USA)*, 62(26): 3034-3037 (26 Jun 1989). DOE Contract AC04-76DP00789.

Quasielastic light scattering from Brownian particles in the rarefied environment of a glow discharge exhibits Gaussianlike intensity correlation functions owing to the long mean free paths of the particles. The shape of the correlation function depends on the particles' average thermal velocity and friction coefficient, which can be related to aggregate mass and structure, and indicates a crossover from kinetic to hydrodynamic behavior.

6450 High Energy Physics

46425 (AECL–9351) **Progress report - Physics and Health Sciences - Physics Section - 1986 July 01 - December 31.** Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Feb 1987. 126p. (PR-PHS-P–2). Order Number DE89634565/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

This progress report of the Physics section of Chalk River Nuclear Laboratories highlights work on major equipment: (1) Tandem Accelerator Superconducting Cyclotron (TASCC), (2) Isotope Separator On Line (ISOL), (3) Spectrometer Array for Particles Produced in Heavy Ion Reactions (SAPPHIRE), and (4) The Double Neutron Spectrometer for neutron scattering (DUALSPEC). Theoretical physics work includes fractal theory, non-topological soliton model of the nucleons, meson currents in relativistic shell model theories and supergravity. Progress of the Sudbury Neutrino Observatory (SNO) and the National Fusion Program (NFP) is discussed. Two commercial aspects are included; the formation of Shar-Buc Enterprises, the first spin-off business of the Research Company and the Applied Neutron Diffraction for Industry (ANDI), a major commercial activity.

46426 (CONF-8905143–12) **The non-perturbative quark-gluon plasma.** Polonyi, J. Massachusetts Inst. of Tech., Cambridge, MA (USA). Center for Theoretical Physics. Jul 1989. 11p. Sponsored by DOE/ER;NSF. DOE Contract AC02-76ER03069. (CTP–1765). From NATO advanced study institute international advanced course on the nuclear equation of state; 12 May - 3 jun 1989. Order Number DE89016583/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

After a brief and subjective evaluation of some talks of this School dealing with the high temperature phase of QCD a mechanism for quark confinement is presented. 18 refs., 5 figs.

46427 (INIS-mf–11514) **Proceedings of the 8 Warsaw symposium on elementary particle physics, Kazimierz, Poland, May 26 - June 1, 1985.** Ajduk, Z. (ed.). Warsaw Univ. (Poland). Inst. Fizyki Doswiadczalnej; Warsaw Univ. (Poland). Inst. Fizyki Teoretycznej. 1985. 692p. (CONF-8505238–: 8. Warsaw symposium on elementary particle physics, 1 May 1985). Order Number DE89635911/JAW. Available from NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS.

These proceedings contain 47 lectures held at the symposium. They deal with pbar-p collider results, phenomenology of electroweak effects, high energy lepton interactions, high energy hadron interactions, quantum chromodynamics, bag model, grand unification, supersymmetry and superstring theory. (M.F.W.).

6451 Particle Interactions and Properties - Experimental

Refer also to citation(s) 45896, 45912, 45938, 45950, 45976, 45982

46428 Search for scalar mesons. Pennington, M.R. (Brookhaven National Lab., Upton, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

The search for I = 0 0^{++} mesons is described. The crucial role played by the states in the 1 GeV region is highlighted. An analysis program that with unimpeachable data would produce definitive results on these is outlined and shown with present data to provide prima facie evidence for dynamics beyond that of the quark model. The authors briefly speculate on the current status of the lowest mass scalar mesons and discuss how experiment can resolve the unanswered issues. 30 references, 6 figures, 1 table.

46429 High intensity hadron facility, AGS II. Lee, Y.Y. (Brookhaven National Lab., Upton, NY (USA)); Lowenstein, D.I. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

There is a large and growing community of particle and nuclear physicists around the world who are actively lobbying for the construction of an accelerator that could provide 1-2 orders of magnitude increase in proton intensity above that of the present AGS. There have been a series of proposals from Canada, Europe, Japan, and the USA. They can all be characterized as machines varying in energy from 12-60 GeV and intensities of 30-100 μA. The community of physicists using the AGS are in a unique position however. The AGS is the only machine available that can provide the beams to execute the physics program that this large international community is interested in. The BNL approach to the communities interests involves a stepwise intensity upgrade program. At present the AGS slow extracted beam current is 1 μA. With the completion of the Booster in 1990 and the associated AGS modifications, the current will rise to 4-5 μA. With the subsequent addition of the Stretcher which is under design, the current will rise to 8-10 μA and approximately 100% duty factor. The possibility of a further enhancement to a current level of 40-50 μA CW is now being examined. 2 figures, 6 tables.

46430 Measuring b → c searching for b → u. Shipsey, I.P.J. (Syracuse Univ., NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

Progress towards the measurement of V_{cb} is reviewed. The search for b → u is discussed. Searches for the charmless modes B → $p\bar{p}\pi(\pi)$ are described in detail. 25 references, 9 figures, 6 tables.

46431 Exotic mesons in $\bar{N}N$ annihilation. Dover, C.B. (Brookhaven National Lab., Upton, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC02-76CH00016. From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

The author investigates the utility of the antinucleon-nucleon ($\bar{N}N$) annihilation process as a means of producing exotic (non $\bar{Q}Q$) mesons. Several examples are considered of J^{PC} exotic formation in the $\bar{p}p \rightarrow \pi X$ reaction. He emphasizes the usefulness of quantum number filtration, achieved by preparing the initial $\bar{p}p$ atom in tagged L = 0,1 states and focusing on selected exclusive final states. 36 references, 4 tables.

46432 CESR single IR upgrade. Rubin, D.L. (Cornell Univ., Ithaca, NY (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

The Cornell Electron Storage Ring operates with seven bunches per beam and 11 ma per bunch to yield a peak luminosity of 1 x 10^{32} cm^{-2} s^{-1} in each of two interaction areas on the Y (5s) resonance. The corresponding daily integrated luminosity is 4.7 pb^{-1}. An electrostatic orbit distortion separates the beams at the 12 parasitic crossings. The beam-beam limit can be upgraded by the elimination of one of the two interaction regions, doubling of the number of bunches per beam from 7 to 14, and enhancing the beam width at the interaction point. Currents of about 300ma/beam will be required to operate the reconfigured machine at its beam-beam limit. The scheme of upgrades is expected to yield a factor of five increase in CESR luminosity to more than 5 x $10^{32}cm^{-2}$ s^{-1}. 14 references, 2 figures, 1 table.

46433 BNL glueball review. Toki, W.H. (Stanford Univ., CA (USA)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). DOE Contract AC03-76SF00515;AC02-76ER01195;AC03-81ER40050. From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

The glueball session of the BNL workshop on glueballs, hybrids and exotic hadrons is reviewed. This includes studies of $K\bar{K}\pi$, $\eta\pi\pi$, $\gamma\rho^0$, $\pi\pi$, $K\bar{K}$, $\eta\eta$, $\phi\phi$, $\rho\rho$, $\omega\omega$, and $K^*\bar{K}^*$ resonances produced in $\gamma\gamma$, J/ψ, K^-p and π^-p reactions. 44 references, 5 figures, 4 tables.

46434 Stimulated Compton backscattering and the high intensity Kapitza-Dirac effect. Schumacher, D.W. (AT & T Bell Laboratories, Murray Hill, NJ (USA)); Bucksbaum, P.H.; Bashkansky, M. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The authors report the scattering of low energy free electrons from an optical standing wave at intensities of 10^{13} to $10^{14}W/cm^2$. This interaction is the high intensity limit of the Kapitza-Dirac effect, wherein electrons Bragg scatter from the standing wave lattice. In this regime, the momentum exchanged exceeds the reciprocal lattice vector by a factor of 500 or more, and the scattering rate is comparable to the optical frequency. The electron motion is most easily analyzed by classical mechanics. 11 refs., 9 figs.

46435 (FNAL/C–89/148-E) **A missing transverse energy analysis of 1.8 TeV $\bar{p}$-p collisions observed at CDF.** The CDF Collaboration. Fermi National Accelerator Lab., Batavia, IL (USA). Jun 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8902122–3: Results and perspectives in particle physics, 26 Feb - 4 mar 1989). Order Number DE89016732/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We summarize a missing transverse energy analysis of 25.3 nb^{-1} of $\bar{p}$-p collision data taken with the CDF detector during its 1987 run. With this analysis we excluded supersymmetric squarks of mass less than 73 GeV, and supersymmetric gluinos of mass less than 74 GeV at the 90% CL. We then present a preliminary missing transverse energy analysis of 1 pb^{-1} of proton-antiproton collision data at c.m. energy of 1.8 TeV observed by the CDF detector during the 1988–1989 Tevatron Collider run. The distribution of events with large missing transverse energy is again found to be consistent with Standard Model expectations. The absence of an excess of events with large missing transverse energy in this preliminary analysis suggests that in the simplest supersymmetry scenario, the existence of supersymmetric squarks of mass less than 150 GeV is unlikely. 6 refs., 6 figs., 3 tabs.

46436 (KEK–88-10, pp. 350-365) **Standard Higgs search at future hadron colliders.** Kondo, T. (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The present note gives a brief review on the possibility of the Higgs particle search at future hadron colliders, SSC and/or LHC. The aim of the review is to introduce current information on Higgs search at future hadron colliders with an emphasis on experimental aspects. Some preliminary work by Monte Carlo simulations is also outlined. A brief and incomplete collection of the detection feasibility studies on the intermediate and heavy mass Higgs boson at future badron collider is presented. The summary is limited to the standard neutral Higgs boson. At future hadron colliders with integrated luminosity of $10^{40}cm^{-2}$, it is shown that the detection is feasible in the mass range of 200-500GeV/c^2 through the 4-lepton decay mode (H->ZZ->1111). For the Higgs mass of above 500GeV/c^2, the 2-lepton 2-neutrino decay mode (H->ZZ->11$\nu\nu$) is quite promising with a detector having good hermeticity. It is expected that the quark-jet tagging would reduce the QCD backgrounds substantially. The detection feasibility of the intermediate-mass Higgs boson depends on the top mass. However, by combining various decay modes, H->$\gamma\gamma$, Zγ, ZZ*, tau$^+$tau$^-$ and (b b-bar), it seems to be possible to cover the mass range of 100-200 Gev/c^2. (Nogami, K.).

46437 (LA-UR–89-2756) **Eta meson production in pion-induced reactions.** Peng, J.C. Los Alamos National Lab., NM (USA). 1988. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8811171–4: 17. INS international symposium on nuclear physics at intermediate energies, 15-17 Nov 1988). Order Number DE89016586/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Recent experiments at LAMPF to study pion-induced eta meson production are discussed. Results from the $\pi^-p \rightarrow \eta n$ and π^- $^3He \rightarrow \eta t$ reactions, potentially useful for tagged η production, are presented. Preliminary results from the $\pi^{\pm}d \rightarrow \eta NN$ reaction, as well as mass and energy dependence of inclusive (π,η) cross sections on heavy nuclei are shown. Information on η-nucleus interaction is extract from these data. 31 refs., 11 figs.

46438 (LA-UR–89-2960) **Hadron distributions at CERN–Heavy Ion experiments.** Jacak, B. HELIOS Collaboration. Los Alamos National Lab., NM (USA). 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8905143–13: NATO advanced study institute international advanced course on the nuclear equation of state, 12 May - 3 jun 1989). Order Number DE89016777/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses the following topics: charged particle pseudorapidity distribution; pion transverse momentum distributions; and kaon production. 24 refs., 8 figs.

46439 (SLAC-PUB–4997) **An experimental review of the decays of the D_S meson.** Schindler, R.H. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jun 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8904226–7: 12. international workshop on weak interactions and neutrinos, 9-14 Apr 1989). Order Number DE89016688/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

In this paper I review the current experimental knowledge of the decays of the D_s meson. I compare D_s properties to those predicted from recent comprehensive D meson decay models that are based on the better measured charmed isodoublet (D^0,D^+). 12 refs., 5 figs., 2 tabs.

46440 (SLAC-PUB–5004) **Multiple-neutral-meson decays of the τ lepton and electromagnetic calorimeter requirements at Tau-Charm Factory.** Gan, K.K. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 13p. Sponsored by U.S. DOE

Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–9: Tau-Charm workshop, 23-27 May 1989). Order Number DE89016689/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This is a study of the physics sensitivity to the multiple-neutral-meson decays of the τ lepton at the Tau-Charm Factory. The sensitivity is compared for a moderate and an ultimate electromagnetic calorimeter. With the high luminosity of the Tau- Charm Factory, a very large sample of the decays $\tau^- \rightarrow \pi^- 2\pi^0 \nu_\tau$ and $\tau^- \rightarrow \pi^- 3\pi^0 \nu_\tau$ can be collected with both detectors. However, with the ultimate detector, $2\pi^0$ and $3\pi^0$ can be unambiguously reconstructed with very little background. For the suppressed decay $\tau^- \rightarrow \pi^- \eta\pi^0 \nu_\tau$, only the ultimate detector has the sensitivity. The ultimate detector is also sensitive to the more suppressed decay $\tau^- \rightarrow K^- \eta \nu_\tau$ and the moderate detector may have the sensitivity if the hadronic background is not significantly larger than that predicted by Lund. In the case of the highly suppressed second-class-current decay $\tau^- \rightarrow \pi^- \eta \nu_\tau$, only the ultimate detector has sensitivity. The sensitivity can be greatly enhanced with a small-angle photon veto. 16 refs., 9 figs., 2 tabs.

46441 (SLAC-PUB–5005) **Physics with low-energy e^+e^- and e^-e^- collisions at Tau-Charm Factory.** Gan, K.K. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–8: Tau-Charm workshop, 23-27 May 1989). Order Number DE89016690/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The physics opportunities in e^+e^- collisions with $\sqrt{s} \simeq$ 1-2 GeV and e^-e^- collisions with $\sqrt{s}$ ~5 GeV at Tau-Charm Factory are being explored. The low-energy e^+e^- option allows precise measurements of e^+e^- cross sections into π's and η's and hence stringent tests of the conserved-vector-current (CVC) hypothesis in τ decays. Precise measurement of the total hadronic cross section also permits a more precise calculation of the muon anomalous magnetic moment (g-2). The e^-e^- option provides an opportunity for a sensitive search for lepton-number violating processes $e^-e^- \rightarrow \mu^-\mu^-$, $\tau^-\tau^-$, $\mu^-\tau^-$ .... The e^-e^- collider also provides an ideal laboratory for two-photon physics with no one-photon background and the direct measurement of the two-photon background in one-photon physics! 19 refs., 4 figs.

46442 (SLAC-PUB–5046) **Monte Carlo study of CP asymmetry measurement of a Tau-Charm Factory.** Karshon, U. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–5: Tau-Charm workshop, 23-27 May 1989). Order Number DE89015636/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It is shown that, for $D^0\bar{D}^0$ mixing of order ~ 1%, it may be possible to observe in a Tau-Charm Factory a CP violation effect in the $D^0\bar{D}^0$ system via a CP asymmetry. The method used is to tag one D by its semi-leptonic decay and to look for decays of the other D into CP eigenstates. It is estimated that within 1 year of running at the designed luminosity of $L = 10^{33}$ cm^{-2}sec^{-1}, ~ 6600 such events can be collected. 8 refs., 8 figs., 1 tab.

46443 (SLAC-PUB–5081) **Strangeonium spectroscopy at the J/ψ: A comparison with kaon hadroproduction.** Ratcliff, B.N. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 27p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–12: Tau-Charm workshop, 23-27 May 1989). Order Number DE89016950/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

An experimental program to study strangeonium mesons produced in the decays of the J/ψ at a τ-charm factory is compared with experiments on similar final states in kaon hadroproduction. The sample sizes and experimental performance required are discussed. The complementarity of different production modes and the importance of a broad programmatic approach to this physics are stressed. 21 refs., 15 figs., 1 tab.

46444 (UCLA–10-P25-112) **[Medium energy particle physics]: Annual progress report.** Nefkens, B.M.K. California Univ., Los Angeles, CA (USA). Oct 1985. 269p. Sponsored by U.S. DOE Energy Research. DOE Contract AS03-81ER40021. Order Number DE89016006/JAW. Available from NTIS, PC A12/MF A01 - OSTI.

Investigations currently carried out by the UCLA Particle Physics Research Group can be arranged into four programs: Pion-Nucleon Scattering; Tests of Charge Symmetry and Isospin Invariance; Light Nuclei (Strong Form Factors of ^{3}H, ^{3}He, ^{4}He; Detailed Balance in pd $\rightleftarrows \gamma^3$H; Interaction Dynamics); and Search for the Rare Decay $M^+ \rightarrow e^+ + \gamma$ (MEGA). The general considerations which led to the choice of physics problems investigated by our group are given in the next section. We also outline the scope of the research being done which includes over a dozen experiments. The main body of this report details the research carried out in the past year, the status of various experiments, and new projects.

6452 Particle Interactions and Properties - Theoretical

Refer also to citation(s) 46372, 46375, 46396, 46433, 46490

46445 (BNL–42957) **Neutrino physics: Summary talk.** Marciano, W.J. Brookhaven National Lab., Upton, NY (USA). Apr 1989. 40p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8809223–8: Workshop on new directions in neutrino physics, 14-16 Sep 1988). Order Number DE89016409/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper is organized as follows: First, I describe the state of neutrino phenomenology. Emphasis is placed on $\sin^2\theta_W$, its present status and future prospects. In addition, some signatures of "new physics" are described. Then, kaon physics at Fermilab is briefly discussed. I concentrate on the interesting rare decay $K_L \rightarrow \pi^0 e^+ e^-$ which may be a clean probe direct CP violation. Neutrino mass, mixing, and electromagnetic moments are surveyed. There, I describe the present state and future direction of accelerator based experiments. Finally, I conclude with an outlook on the future. Throughout this summary, I have drawn from and incorporated ideas discussed by other speakers at this workshop. However, I have tried to combine their ideas with my own perspective on neutrino physics and where it is headed. 49 refs., 3 figs., 4 tabs.

46446 (BONN-IR–88-38) **Simulation calculations on the measurement of electroweak processes in the ZEUS experiment.** Gry, O. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Jul 1988. 62p. (In German). Order Number DE89915157/JAW. Available from NTIS (US Sales Only), PC A04/MF A01.

The present thesis deals with the determination of the kinematical variables Q^2, x, and y for the study of electroweak processes in the ZEUS experiment. The focus lies thereby on high Q^2 range which will be reached experimentally for the first time at HERA (Q^2>1000 GeV^2). Beyond it is studied how precisely two parameters of the electroweak theory, $\sin^2\theta_w$ and the rho parameter, can be determined because of statistical and experimental errors. For NC events the kinematical variables can be determined over a wide kinematical range both via the electron and via the produced hadrons. Corresponding to these two possibilities both the properties of the electromagnetic calorimeter and the hadronic calorimeter are regarded. On the hadronic side furthermore a study of the influence of the beam-pipe section and the error correlated to this in the application of the Jacquet-Blondel formalism is performed. By this the introduction and determination of a correction matrix A results which in spite of systematical shift of the events to smaller values of x and Q^2 allows to determine from just these $\sin^2\theta_w$ with an error only unessentially larger against the ideal case without beam-pipe section. Finally as result of the studies some fit results concerning the errors of $\sin^2\theta_w$ and the rho parameter both on the electron and on the hadron side are presented. (orig.).

46447 **QCD tests of: G(1.6) = glueball.** Narison, S. (U.S.T.L., Montpellier (France)). pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

The evidence within QCD (spectral sum rules, low energy theorems and current algebra for the pseudoscalar nonet) that the

G(1.6) meson seen at GAMS is a relatively pure gluonion state is presented. The suppression of the G(1.6) coupling to Goldstone boson pairs being consistent with the existence of a low mass $\sigma(0.9)$ state which saturates the (P —θ—$^{\mu}_{\mu}$ P) vertex (P ≡ π,K). The author presents a crude estimate of the G, fsub 0 (1.3) and σ two photon widths and of their production in ψ and Y radiative decays. 7 references.

46448 Inevitable dibaryons. Maltman, K. (Los Alamos National Lab., NM (USA)); Goldman, T.; Stephenson, G.J. Jr.; Schmidt, K.E.; Wang, F. pp. 729 of Glueballs, hybrids, and exotic hadrons. Chung, Suh-Urk (ed.) American Institute of Physics, New York, NY (1989). From BNL workshop on glueballs, hybrids and exotic hadrons; 29 Aug - 1 sep 1988.

Certain qualitative features common to all phenomenological models of hadron structure based on the idea of a separation of perturbative and confinement regimes in QCD necessarily lead to the prediction that, independent of more detailed dynamics, well-defined positive parity channels must support dibaryon resonances. These channels are identified and the qualitative physics underlying this claim discussed. Of these states, only one, with quantum numbers IJ^P-03$^+$, is non-strange. Cross-section estimates are presented for its production in $\pi d \rightarrow \pi X$ and $np \rightarrow X$. 11 references, 1 table.

46449 (DOE/ER/03075–T2) **CY90 budget submission for theoretical research on elementary particles and interactions.** Appelquist, T. Yale Univ., New Haven, CT (USA). Dept. of Physics. Jun 1989. 47p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER03075. Order Number DE89016497/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses budgetary information on theoretical research of elementary particles at Yale University. Individual research is discussed briefly. (LSP)

46450 (DOE/ER/13065–587) **A comparison of quark and gluon jets produced in 3-jet e^+e^- annihilation events.** Bodek, A. The AMY Collaboration. Rochester Univ., NY (USA). Dept. of Physics and Astronomy. 8 Aug 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76ER13065. (CONF-8906199–1: 9. international conference on physics in collision, 19-21 Jun 1989). Order Number DE89016336/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Three-jet events produced in e^+e^- annihilations are used to provide comparisons between quark and gluon jets. Differences between quark-induced and gluon-induced jets are observed. Quark jets tend to have a more tightly collimated structure than gluon jets, which is reflected in the concentration of a larger fraction of the jet's energy near the jet axis. These properties can be used to enhance signals for new particles produced in e^+e^- and hadron colliders, and discriminate against QCD backgrounds from gluon jets. 11 refs., 4 figs.

46451 (DOE/ER/40423–05-P9) **Sea quarks and the hadron spectrum.** Patel, A.; Gupta, R.; Kilcup, G.W.; Sharpe, S.R. Washington Univ., Seattle, WA (USA). Dept. of Physics. Apr 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AS06-88ER40423. (CERN-TH–5379/89). Order Number DE89017323/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We present lattice Monte Carlo results demonstrating the effects of dynamical quarks on the hadron spectrum. We show that the sea quarks do not influence the nucleon and the rho in an identical manner, and the ratio M_N/M_ρ decreases as the sea quark mass is decreased. We also find a large value for the sea quark contribution to the matrix element $\langle N|\bar{u}u - \bar{d}d|N\rangle$. 16 refs., 2 figs., 3 tabs.

46452 (FNAL/C–89/168-T) **The theory of heavy flavour production.** Ellis, R.K. Fermi National Accelerator Lab., Batavia, IL (USA). 9 Aug 1989. 36p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8907134–1: 17. SLAC summer institute: physics at the 100 GeV mass scale, 10-21 Jul 1989). Order Number DE89016734/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The theory of heavy quark production in hadronic reactions is reviewed. Rates for the production of charm, bottom and top quarks at energies of current interest are presented. 34 refs., 19 figs., 2 tabs.

46453 (IC–89/20) **On the possibility of studying extra gauge Z'-boson effects in e^+e^- -> l^+l^- at TRISTAN.** Pankov, A.A.; Satsunkevich, I.S. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 16p. Order Number DE89635921/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A new possibility is suggested in order to study in the process e^+e^- -> l^+l^- at energies below the standard Z-boson production threshold the effects coming from an extra neutral gauge boson Z' in superstring-inspired E_6 models. It is shown that at energies $\sqrt{s} \sim$ 50 - 60 GeV the cross-section for relatively light Z'($M_{Z'} <$ or approx. $2.5M_Z$) can have an interference dip absent in the standard model. The depth and energy coordinates of this dip depend on Z'-boson parameters. This information concerning the Z'-boson can be obtained by making use of TRISTAN, which is a high-luminosity set-up. (author). 8 refs, 7 figs.

46454 (IC–89/43) **Can we treat the confinement as a pure relativistic effect?.** Kagramanov, E.D.; Nagiyev, Sh.M.; Mir-Kasimov, R.M. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 7p. Order Number DE89635929/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The attempt was made to explain the confinement property of strong interactions from geometrical point of view based on the covariant finite-difference Schroedinger equation in the relativistic configurational r-vector space. It is shown that the solution of this equation for the quark-antiquark system exist, which contains a universal damping factor. (author). 9 refs.

46455 (INIS-BR–1573) **Center-of-mass corrections in the S+V potential model.** Palladino, B.E. Instituto de Fisica Teorica, Sao Paulo, SP (Brazil). Feb 1987. 90p. (In Portuguese). Order Number DE89635940/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

Center-of-mass corrections to the mass spectrum and static properties of low-lying S-wave baryons and mesons are discussed in the context of a relativistic, independent quark model, based on a Dirac equation, with equally mixed scalar (S) and vector (V) confining potential. (author).

46456 (INIS-SU–96, pp. 49-51) **Analysis of polarization observables in electrodisintegration of tensorly polarized deuterons α-vector (e,pn)e'.** Rekalo, M.P. (AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Fiziko-Tekhnicheskij Inst.); Gakh, G.I.; Rekalo, A.P. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR). Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike. 1987. (In Russian). In *General and nuclear physics. Scientific-technical collection of papers.* Order Number DE89012202/JAW. Available from NTIS (US Sales Only), PC A07/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2(38); no. 3(39).

Within the framework of relativistic impulse approximation polarization effects in the d-vector(e,pn)e' reaction on a target with tensor polarization are analyzed. The most interesting asymmetries in the case kinematically equivalent to disintegration of tensorly polarized deuteron are calculated. 6 refs.; 3 figs.

46457 (KEK–88-10, pp. 8-15) **Large enhancement of the production of ultraheavy quark bound states via Higgs-boson exchange in multi-TeV collider energies.** Inazawa, H. (Shoin Women's Univ., Kobe (Japan)); Morii, T. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The production of bound states composed of the ultraheavy quark via Higgs-boson exchange is hugely enhanced in multi-TeV collider energies. In the two-Higgs-doublet model the wave function at the origin of such a bound state is enhanced further by the ratio of two vacuum expectation values v_D/v_U. (author).

46458 (KEK–88-10, pp. 23-27) **Classical solutions in the electroweak theory.** Fujii, Kazuyuki (Kyushu Univ., Fukuoka (Japan). Faculty of Science); Otsuki, Shoichiro; Toyoda, Fumihiko. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan).

Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

Relations among some classical solutions of the SU(2) gauge-Higgs system are investigated. They include the 'spherically' symmetric sphaleron as a saddle point solution and Nambu's string-monopole configuration which is 'axially' symmetric. They are transformed to each other by a singular gauge transformation or Hopf projection at r->∞. Although their configurations are not topological ones, the noncontractible loops and spheres are calucurated by extending the Hopf projection. (author).

46459 (KEK–88-10, pp. 35-46) **CP-violation in SUSY.** Kizukuri, Yoshiki (Tokai Univ., Hiratsuka, Kanagawa (Japan). Dept. of Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

CP-violation sources inherent in supersymmetric models and their phenomenological aspect are reviewed. The models discussed in this review are asuumed to be derived from N = 1 supergravity theories at the Planck mass scale, and have an SU(3) x SU(2) x U(1) symmetry at the low energies. (author).

46460 (KEK–88-10, pp. 99-121) **Leptonic gluon in the unified subquark model.** Akama, Keiichi (Saitama Medical Coll., Moroyama (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The leptonic gluon, i.e. the composite vector boson made of the subquark carrying the leptonic color and its anti-particle, would render important evidences for the subquark model. A unified subquark model including it is constructed, and its properties are investigated. (author).

46461 (KEK–88-10, pp. 1-7) **Testing the standard electroweak theory through the measurement of $\sigma_{tot}(e^+e^- \rightarrow W^+W^-)$.** Hioki, Zenro (Tokushima, Univ. (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The standard SU(2) x U(1) gauge theory of the electroweak interaction has been so far intensively studied in an energy region up to 100GeV. It is consequently known that only this theory, called the electroweak theory, can describe various processes successfully. In connection with the W pair production in LEP II, the present report addresses the M_w determination from $\sigma_{tot}(e^+e^- \rightarrow W^+W^-)$ since this subject includes some misleading and confusing problems. Precise determination of M_w and M_z are very important for testing the electroweak higher order effects clearly. For W mass determination, it is found that the region $\sqrt{S} \leq 2M_w + 10GeV$ is obviously inadequate while threshold behavior of σ_{tot} is quite universal and therefore this region is suitable. Further calculations are made based on observations. Treating the ZWW coupling constant g_{zww} as a free parameter and taking account of actual experimental error of g_{cc}, g_{NC} and $\sin^2\theta_W$, etc., examination is made on how precisely M_w can be determined in the threshold region. As a result, it is found that $\Delta M_w \leq$ 0.2-0.3GeV although it is rather a rough estimate. Anyway, it may be expected that the kinematical mass of W can be determined from $\sigma_{tot}(e^+e^- \rightarrow W^+W^-)$ only in the threshold region. (Nogami, K.).

46462 (KEK–88-10, pp. 16-22) **Sphaleron creation in collisions?.** Aoyama, Hideaki (Kyoto Univ. (Japan). Dept. of Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The report reviews analyses of the sphaleron creation rate in high energy collisions. Sphaleron is a finite energy static solution in the standard SU(2) X U(1) electroweak theory. It is in the vaccum sector, i.e., is topologically trivial. It is unstable, and has mass of the order of M_w/α_{wk}, ~ 10 Tev. Since it can 'mediate' Δ(B+L)not =0 processes, it may have important effects in experiments in the TeV scale. To examine the qq-bar->Sphaleron process, sphaleron is assumed to be a coherent state of free field operators. Then, the rate for the desired process can be written as a convolution of the qq-bar->nW amplitude and the overlap integral between the nW state and sphaleron state. In this particular gauge, the sphaleron solution is singular at origin, which leads to some (gauge-dependent) divergences. Since this is purely a gauge artifact, this problem is avoided by defining the sphaleron as a coherent state of gauge-invariant field operators of specific forms. This effectively provides a gauge-invariant cutoff of the orign. It is found that for $\lambda \sim g^2$, the expected number N_{wz} of the W's and Z's are ~55, with an energy of 11 TeV. Since $M_{sp} \sim$10Tev, the sphaleron can be regarded as a loosely bound system of W's and Z's in this range of the coupling constants. Furthermore, momentum spread of these W's and Z's are of $O(M_w)$, rather small compared to M_{sp}. After some calculations, the desired amplitude is obtained in an approximate form. (N.K.).

46463 (KEK–88-10, pp. 131-151) **New physics at TeV scale.** Terazawa, Hidezumi (Tokyo Univ., Tanashi (Japan). Inst. for Nuclear Study). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

Many important predictions mostly in composite models which have already been checked or will be tested in the future experiments at TeV energy scale are summarized. They include predictions for (1) the gauge coupling constants (and the weak mixing angle), (2) the masses of the Higgs scalar and top quark, (3) the quark mixing parameters, (4) the excited quarks, leptons, gauge bosons and Higgs scalars and (5) the exotic particles, especially the 'color ball'. Various topics including (1) supersymmetry, (2) superstring phenomenology, (3) technicolor, (4) composite model, (5) new gauge interaction (5)-th force, horizontal gauge model, etc., (6) flavor mixing and symmetry violation (B^0-B-bar^0 mixing, lepton mixing, CP violation search, etc.), (8) under ground experiments and ν physics (solar ν problem, ν from supernova, etc.) and (7) physics perspectives in TRISTAN/SLC/LEP/HERA/TEVATRON/SCC experiments are also discussed. (author).

46464 (KEK–88-10, pp. 191-196) **Rare processes and B physics.** Lim, Chong-Sa (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

It is pointed out that in rare b-decay processes new features, which are not shared by rare decays in K meson system, emerge and are important in the evaluation of the decay rates. Namely, long-distance contribution due to charmed hadrons together with the effect of rather large external quark (b) mass are shown to be even dominant in some decay processes, for the allowed range of t-quark mass. (author).

46465 (KEK–88-10, pp. 197-206) **CP violations in the Neutral B meson system and the four-generation model.** Tanimoto, Morimitsu (Ehime Univ., Matsuyama (Japan). Science Education Lab.). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The B_d^0-B-bar$_d^0$ mixing observed by ARGUS Collaboration suggests that the non-lepton asymmetry in the B_d^0-B-bar$_d^0$ system (A_d)

is very large even in the three-generation model, while the non-lepton asymmetry in the B_s^0-B-bar$_s^0$ system(A_s) is suppressed and the lepton asymmetries (a_d, a_s) are very small. However, the asymmetries A_s, a_d and a_s could be also large in the four-generation model. We investigate the relation among A_d, A_s, a_d, a_s and the value of the B_s^0-B-bar$_s^0$ mixing systematically, assuming the relevant hierarchy of the fourth column in the 4 x 4 KM matrix such as (λ^3, λ^2, λ, 1) and (λ^3, λ^3, λ, 1) with the Wolfenstein parameter λ = 0.22. We have found that the predicted values of A_d, A_s, a_d and a_s are strongly restricted by the experimental value of ϵ_K in the neutral K meson system, and have obtained some interesting results which are contrasted to those of the three-generation model. (author).

46466 (KEK–88-10, pp. 210-217) **Extra charged Higgs contributions to flavor changing processes.** Kurimoto, Takeshi (Osaka Univ., Toyonaka (Japan). Coll. of General Education). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

General form of quark-charged Higgs interaction Lagrangian is derived, where neutral flavor conservation is taken into account. Contributions to $\Delta S(\Delta B) = 2$ effective Hamiltonian are estimated by using the obtained Lagrangian. We also show concrete examples of that interaction in some models. (author).

46467 (KEK–88-10, pp. 229-234) **K_L^0 -> μe experiments exploring 100 TeV mass scale.** Shinkawa, Takao (National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

Three groups are searching for the K_L^0 -> μe decay, which is a lepton number violating process, with branching ratio sensitivities of $10^{-10} \sim 10^{-12}$ at BNL and KEK. They have preliminary results of 1987 and 1988 data and two experiments will continue data taking until 1989 summer. (author).

46468 (KEK–88-10, pp. 218-228) **Phenomenology of spontaneous CP violation model with neutral flavor conservation.** Kurimoto, T. (Osaka Univ., Toyonaka (Japan). Coll. of General Education); Tanaka, M.; Takasugi, E. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The report addresses an analysis of a spontaneous CP violation model proposed by Ecker, Grimus and Neufield which satisfies neutral flavor conservation in the Higgs sector. Their model has a very interesting Kobayashi-Maskawa matrix which leads to phenomenological results different from standard model. A detailed analysis is made of the phenomenological consequense of this KM matrix, which is explicitly expressed here in a 4 x 4 orthogonal form in the expansion of λ (Cabibbo angle). Wolfenstein type parametrization is derived, and used to analyze ϵ, ϵ'/ϵ parameters in the K system, B deg - B-bar deg oscillation. Then the CP violation asymmetry in Bdeg meson system is examined. The effects of charged Higgs bosons are neglected in the analysis. However, the calculations would be valid for heavy charged Higgs bosons, and light charged Higgs bosons are excluded by electric dipole moment of neutron to which charged Higgs bosons contribute in the one loop level. It is emphasized that nonleptonic decay CP asymmetry in the tree approximation is independent of decay modes in this model, and this is the feature quite different from standard model. (Nogami, K.).

46469 (KEK–88-10, pp. 247-260) **Neutrino oscillations as a possible solution to the anomalous atmospheric neutrino flux.** Hidaka, K. (Tokyo Gakugei Univ., Koganei (Japan)); Honda, M.; Midorikawa, S. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The masses and mixing pattern of neutrinos are long-standing problems in particle physics. The deficit of neutrino induced muon events recently observed at Kamiokande is very interesting, but the analyses made so far have been based on neutrino flux calculations that neglect the muon polarization effect. Muons produced in pion decay are completely polarized. The electron-type and muon-type neutrios in the muon decay tend to be emitted in the forward and backward directions with respect to the muon momentum, respectively. This effect makes the energy spectrum of the ν_μ flux soft and that of the ν_e hard. It is shown here that this effect is not large enough to explain the deficit. Investigation of the atmospheric the ν_μ and ν_e fluxes indicates that they deviate significantly from the expected values even if the investigation takes into account the effect of the polarization of the muons which are produced mainly by π -> $\mu\nu$ decay. It is found possible to explain the data by three-neutrino oscillations. The two neutrino oscillations ν_e reversible ν_μ are not favored. Models of three neutrino flavors with neutrino mass squared differences of order $10^{-2}eV^2$ can solve both the solar and the atmospheric neutrino problems simultaneously. (N.K.).

46470 (KEK–88-10, pp. 281-289) **Possible test of asymptotic behaviours from sum rules.** Igi, Keiji (Tokyo Univ. (Japan). Dept. of Physics); Kroll, P. National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

In 1987, the UA4 collaboration measured the ratio rho(p p-bar) of real to imaginary part of the (pp) forward scattering amplitude at 546GeV centre-of-mass energy. Their result rho(p p-bar) = 0.24+-0.04 is surprisingly large. Normally one would expect rho(p p-bar) to lie between 0.11 and 0.15 from the dispersion approach. The present report describes how to test the crossing-odd part of high energy total cross sections of several models (including the odderon) using sum rules from a new stand point. The P' sum rule was proposed to test the J-plane singularities with vacuum quantum number, and P'(f) Regge trajectory was discovered a long time ago. Here, this idea is followed to the crossing-odd amplitude but in a somewhat modern way. The crossing-odd (spin averaged) forward amplitude for pp and (p p-bar) scattering is defined and an unsubtracted dispersion relation of a form suitable for numerical calculation is derived. Theoretical calculations of $ReF^{(-)}(\omega)$ at high energies are compared with experimental values. A study is made to check the validity of the unsubtracted dispersion relation which indeed is closely consistent with Regge asymptotics. This does not give such a large value for rho(p p-bar) = 0.24+-0.04 as measured by UA4 at 540GeV. Other asymptotic behaviours such as the odderon or a real constant or combinations are not ruled out completely but the strength of these terms has to be small. (Nogami, K.).

46471 (KEK–88-10, pp. 341-349) **Heavy quarks and leptons.** Asano, Yuzo (Tsukuba Univ., Tsukuba, Ibaraki (Japan)). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

Detectability of heavy quarks and leptons in high energy hadron-hadron collision is discussed from an experimental point of view. Some of the problems encountered in the experiment are pointed out, but their solutions are not given yet. (author).

46472 (KFKI–1989-22/A) **Simple expression for the entropy of a fireball from experimental strange particle ratios.** Levai, P.; Lukacs, B.; Zimanyi, J.; Heinz, U. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Apr 1989. 32p. Order Number DE89635938/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An expression is derived for the specific entropy S/N_B in a non-interacting, non-relativistic Boltzmann gas mixture in terms of strange particle ratios. Then the influences of relativistic and quantum statistical effects and the role of hadronic interactions on

reconstructing the specific entropy from the particle ratios are studied. Since neglect of the relativistic effects causes the largest correction, they are included in an improved expression. The resulting formula gives the specific entropy from the observed particle ratios with less than 20% error. (author) 24 refs.; 3 figs.

46473 (NBI-HE–89-26) **A condensate solution of the electroweak theory which interpolates between the broken and the symmetric phase.** Ambjoern, J.; Olesen, P. Niels Bohr Inst., Copenhagen (Denmark). May 1989. 12p. Order Number DE89915284/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We discuss a magnetic type solution of the classical electroweak equations with the property that for fields larger than m_w^2/e a W- and Z-condensate is formed. When the average magnetic field reaches the value $m_w^2/e\ \cos^2\theta$ the SU(2)xU$_Y$(1) symmetry is restored. We compare to the finite temperature case. It is mentioned that large magnetic fields of order m_w^2/e (realized e.g. near the superconducting cosmic string) can actually be achieved in earth-bound laboratories as the field surrounding quarks in e.g. proton-proton collisions with more than 1 TeV energy. However, we do not know if the field lasts long enough to produce a W-Z plasma. (orig.).

46474 (ORNL/TM–11257) **Calculated inclusive neutron production from 400 GeV proton-nucleus collisions.** Alsmiller, R.G. Jr.; Alsmiller, F.S.; Hermann, O.W. Oak Ridge National Lab., TN (USA). Aug 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016939/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Calculated inclusive neutron production from 400 GeV proton-nucleus collisions is presented and compared with experimental data. Target nuclei H, Be, Cu, and Pb are considered and the comparisons cover the laboratory energy range of 20 to 400 GeV, and angular range 0.7 to 10 mr. Moderately good agreement between the calculated and experimental data is found, but the agreement in the case of Be, Cu and Pb is significantly better than in the case of H. 8 refs., 4 figs.

46475 (RAL–89-021) **E$^+$e$^-$ annihilation at high energies.** Marshall, R. Rutherford Appleton Lab., Chilton (UK). May 1989. vp. Available from British Library, Lending Division, Boston Spa, Wetherby, West Yorks.

The experimental physics programme of PEP and PETRA is presented. The data from 11 independent experiments are collated and compared with theory. The review starts with a brief history of e$^+$e$^-$ interactions and then gives brief technical details of the two accelerators and the 11 experimental detectors. The physics of hadron production is considered and the production yield per event of hadrons detected is given. The confrontation of the measurements of hadron production with quantum chromodynamic (QCD) theory is considered together with the status of the understanding of fragmentation. A chapter is devoted to the electroweak interaction and results are presented from an analysis combining the data from the various experiments on lepton and quark pair production. Some aspects of heavy flavour physics are described using measurements on the decays of tau leptons and the c and b quarks. In the case of the tau the most accurate determination to date of the Fermi constant, derived from tau decay is given, together with the first ever result on the value of g-2 for the tau. The most stringent limits obtained so far are presented on the mass of the tau neutrino, and on the number of neutrino generations, obtained by combining the results from several experiments. A summary of the searches for new particles is given and the review ends with a look at the new e$^+$e$^-$ accelerators now coming into operation and the prospects for continuing developments into the next century. (author).

46476 (RAL–89-038) **Polarised structure functions in the parton model.** Jackson, J.D.; Ross, G.G.; Roberts, R.G. Rutherford Appleton Lab., Chilton (UK). May 1989. 11p. Available from British Library, Lending Division, Boston Spa, Wetherby, West Yorks.

It is shown that a covariant form of the parton model is necessary for consistent predictions of the nucleon spin structure functions. Sum rules relating g_2 to g_1 are derived and the limits of their applicability discussed. The measurement of g_1 is shown to give a direct estimate of the mean k_T as a function of x yielding values consistent with experiment and with an independent estimate we derive from a covariant formulation of the parton model for the unpolarised structure functions. With the assumption of dominance of $k^2 \simeq 0$, it is shown that the polarised and unpolarised covariant parton distributions themselves as functions of pcenter dotk can be extracted from the data, giving a complete specification of the covariant relativistic parton model. (author).

46477 (SLAC-PUB–5018) **Predictions for CP violation.** Gilman, F.J. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8906204–1: International symposium on heavy quark physics, 13-17 Jun 1989). Order Number DE89016691/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Predictions for CP violation in the three-generation Standard Model are reviewed, especially as they pertain to the K and B meson systems. 39 refs., 19 figs.

46478 (SLAC-PUB–5025) **Renormalization schemes: Where do we stand?.** Ward, B.F.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515;AS05-76ER03956. (UTHEP–89-0701;CONF-8907136–1: NATO advanced research workshop on radiative corrections: results and perspectives, 9-14 Jul 1989). Order Number DE89015632/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

We consider the status of the current approaches to the application of the renormalization program to the standard $SU_{2L} \times U_1$ theory from the standpoint of the interplay of the scheme chosen for such an application and the attendant high-precision tests of the respective loop effects. We thus review the available schemes and discuss their theoretical relationships. We also show how such schemes stand in numerical relation to one another in the context of high-precision Z^0 physics, as an illustration. 15 refs., 2 figs., 2 tabs.

46479 (SLAC-PUB–5030) **V_{cd} and V_{cs} from current models.** Ward, B.F.L. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515;AS05-76ER03956. (UTHEP–89-0702;CONF-8905144–7: Tau-Charm workshop, 23-27 May 1989). Order Number DE89015634/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

We discuss the theoretical uncertainties attendant to the determination of $|V_{cd}|/|V_{cs}|$ from semileptonic D decay. Four different theoretical approaches are considered. Currently, agreement at the level of a factor of 2 for the various theoretical approaches exists so that, indeed, precise experimental data – such as precise lepton energy spectra and decay width data – would discriminate among the models considered. 8 refs., 1 fig.

46480 (SLAC-PUB–5051) **Phenomenology of the CKM [Cabibbo-Kobayashi-Maskawa] matrix.** Nir, Y. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Jul 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8906204–2: International symposium on heavy quark physics, 13-17 Jun 1989). Order Number DE89015639/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The way in which an exact determination of the CKM matrix elements tests the Standard Model is demonstrated by a two generation example. The determination of matrix elements from meson semi-leptonic decays is explained, with an emphasis on the respective reliability of quark level and meson level calculations. The assumptions involved in the use of loop processes are described. Finally, the state of the art of our knowledge of the CKM matrix is presented. 19 refs., 2 figs.

46481 (SLAC-PUB–5083) **Unsolved problems in hadronic charm decay.** Browder, T.E. Stanford Linear Accelerator Center, Menlo Park, CA (USA). Aug 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8905144–11: Tau-Charm workshop, 23-27 May 1989). Order Number DE89016951/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper describes several outstanding problems in the study of hadronic decays of charmed mesons where further experimental work and theoretical understanding is needed. Four topics are stressed: double Cabibbo suppressed decays (DCSD) of D^+ mesons, hadronic D_s decays, weak hadronic quasi-two-body decays to pairs of vector mesons, and penguin decays of D mesons. 24 refs., 10 figs., 5 tabs.

46482 Remarks on the mass scales, mixing angles, and signatures of the fourth-generation quarks. Hamzaoui, C. (Department of Physics, Concordia University, Montreal, Quebec, Canada H3G IM8(CA)); Sanda, A. I.; Soni, A. *Physical Review Letters (USA),* 63(2): 128-131 (10 Jul 1989).

Assuming that the fourth family makes an appreciable contribution to B mixing, assuming some mild properties of the (4×4) Cabibbo-Kobayashi-Maskawa matrix, and taking the lattice determination of the pseudoscalar decay constant for B seriously, we arrive at a lower bound on m_t, i.e., $m_{t'} \gtrsim 500$ GeV. If perturbative unitarity is to be preserved, i.e., $m_{t'} \sim 500$ GeV, then our analysis also implies that the top quark is unlikely to be lighter than ≈80 Gev. Experimental consequences for rare B decays, and CP violation in B decays are also discussed.

6453 Particle Invariance Principles and Symmetries

Refer also to citation(s) 46497, 46498

46483 (BONN-IR–88-41) **Conformal invariance and critical properties of quantum chains with defects.** Schlottmann, M. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Jul 1988. 36p. (In German). Order Number DE89915158/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

This thesis is based on the question whether and how the introduction of defects in two-dimensional conformal-invariant systems, especially models the transfer matrix of which is given by one-dimensional Z_n symmetric quantum chains, influences the conformal symmetry. First by duality transformation of general Z_n symmetric quantum chains under exact regardment of boundary conditions the relation of systems with defects to systems which interact with surface fields is exposed. Thereafter it was shown that the conformal symmetry by switching on of defects for certain defect configurations is not completely broken. The question whether these results can be transferred to more general models was studied on the example of the three-state Potts model with a defect by means of numerical methods. A transition scheme for the Virasoro representations in the interpolation between the representations at the known points in the space of the defect parameters could be proposed by which the numerical results are consistent. However it is to be stated that the numerical results give in no way a proof for the partial conservation of conformal invariance; an analytical construction of the Virasoro generators analoguously to the Ising model has not succeeded. Also it was stated that no additional structure in form of Kac-Moody algebras is present. (orig./HSI).

46484 (IC–89/68) **Construction of two dimensional super potentials for classical super systems.** Mishra, S.C. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 6p. Order Number DE89635733/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Construction of super potentials for two dimensional classical super systems (for $N \geq 2$) is carried out. Some interesting potentials have been studied in their super form. (author). 3 refs.

46485 (KEK–88-10, pp. 173-190) **Scale-invariant technicolor and a technidilaton.** Yamawaki, Koichi (Nagoya Univ. (Japan). Dept. of Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

As to the mass of quarks and leptons, the problem of excessive flavor-changing neutral currents (FCNC's), roughly 10^3 times the experimental limit, has long been a fatal disease to the technicolor (TC) theories. Also, most TC models predict light pseudo Nambu-Goldstone bosons (PNGB's) with $J^{PC} = 0^{-+}$ in the reion <10 GeV, which are already excluded by the experiment. Because of these, these has been a widely spreading folklore that TC is dead. It is argued here, however, this is no longer true in the modern version of TC, which, in contrast to the classical one, is not a naive scale-up of QCD. The report describes the scale-invariant technicolor model characterized by the ladder Schwinger-Dyson equation. It is found that the theory has a non-trivial ultraviolet fixed point with large anomalous dimension, which naturally supresses the flavor-changing neutral currents (FCNC's) and at the same time raises the mass of the problematic light technipions. The model is expected to predict a dilaton (technidilaton), a light $J^{PC}=O^{++}$ pseudo Nambu-Goldstone bosons associated with the spontaneous breakdown of the scale invariance, whose dynamical issues are argued in detail. The model is compared with the running coupling constant varied slowly in the ladder-like Schwinger-Dyson equation; it is found that enough suppression of FCN's is only possible in the scale-invariant model. (N.K.).

6454 Field Theory

Refer also to citation(s) 45797, 46434, 46445, 46638

46486 (BNL–42493) **Quantization of anomalous gauge theories on a lattice.** Aoki, Sinya. Brookhaven National Lab., Upton, NY (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8909112–1: Symposium lattice '88, 22-25 Sep 1989). Order Number DE89010247/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We discuss advantages and disadvantages of three equivalent lattice actions proposed before for anomalous chiral gauge theories. Applications to the chiral Scwinger model and the four dimensional chiral QED are presented. 12 refs.

46487 (BNL–42855) **The standard model and beyond.** Marciano, W.J. Brookhaven National Lab., Upton, NY (USA). May 1989. 31p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8810409–1: 10. Autumn School on physics beyond the standard model, 10-14 Oct 1988). Order Number DE89015112/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In these lectures, my aim is to present a status report on the standard model and some key tests of electroweak unification. Within that context, I also discuss how and where hints of new physics may emerge. To accomplish those goals, I have organized my presentation as follows. I survey the standard model parameters with particular emphasis on the gauge coupling constants and vector boson masses. Examples of new physics appendages are also commented on. In addition, I have included an appendix on dimensional regularization and a simple example which employs that technique. I focus on weak charged current phenomenology. Precision tests of the standard model are described and up-to-date values for the Cabibbo-Kobayashi-Maskawa (CKM) mixing matrix parameters are presented. Constraints implied by those tests for a 4th generation, extra Z' bosons, and compositeness are discussed. An overview of the physics of tau decays is also included. I discuss weak neutral current phenomenology and the extraction of $\sin^2\theta W$ from experiment. The results presented there are based on a global analysis of all existing data. I have chosen to concentrate that discussion on radiative corrections, the effect of a heavy top quark mass, implications for grand unified theories (GUTS), extra Z' gauge bosons, and atomic parity violation. The potential for further experimental progress is also commented on. Finally, I depart from the narrowest version of the standard model and discuss effects of neutrino masses, mixings, and electromagnetic moments. 32 refs., 3 figs., 5 tabs

46488 (BNL–42968) **Lattice fields and strong interactions.** Creutz, M. Brookhaven National Lab., Upton, NY (USA). Jun 1989. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH00016. (CONF-8905143–3: NATO international advanced course on the nuclear equation of state, 12 May - 3 jun 1989). Order Number DE89015099/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

I review the lattice formulation of gauge theories and the use of numerical methods to investigate nonperturbative phenomena. These methods are directly applicable to studying hadronic matter at high temperatures. Considerable recent progress has been made in numerical algorithms for including dynamical fermions in such calculations. Dealing with a nonvanishing baryon density adds new unsolved challenges. 33 refs.

46489 (CONF-8903130–2) **Singularity theory and N = 2 superconformal field theories.** Warner, N.P. Massachusetts Inst. of Tech., Cambridge, MA (USA). Center for Theoretical Physics. 1989. 7p. Sponsored by DOE/ER;NSF. DOE Contract AC02-76ER03069. (CTP–1745). From Strings '89 conference; 13-18 Mar 1989. Order Number DE89016582/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The N = 2 superconformal field theories that appear at the fixed points of the renormalization group flows of Landau-Ginsburg models are discussed. Some of the techniques of singularity theory are employed to deduce properties of these superconformal theories. These ideas are then used to deduce the relationship between Calabi-Yau compactifications and tensored discrete series models. The chiral rings of general N = 2 superconformal theories are also described. 14 refs.

46490 (DOE/ER/40423–03-P9) **Analytic strong-coupling expansion in 1/e for the electron propagator without fermion loops in quantum electrodynamics.** Carrier, D. Washington Univ., Seattle, WA (USA). Dept. of Physics. 1989. 33p. Sponsored by U.S. DOE Energy Research. DOE Contract AS06-88ER40423. Order Number DE89017322/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Starting from the path-integral representation for the electron propagator without fermion loops in QED, we analytically investigate the strong-coupling behavior in an arbitrary background electromagnetic field through a series expansion in powers of 1/e. Contrary to the perturbation theory expansion in e the new series only contains positive powers of the derivative operator p. Due to infrared singularities in the path integral the series does not exist beyond the lowest orders, although one can build a systematic expansion in powers of p (not 1/e) which can be calculated up to any order. To handle infinities we regularize using a Pauli-Villars approach. The introduction of fermion loops would not correspond to higher orders in 1/e, so a priori our results are only pertinent to the sector of QED we have chosen. 17 refs., 1 fig.

46491 (FNAL/C–89/164-T) **Spontaneous symmetry breaking in 4-dimensional heterotic string.** Maharana, J. Fermi National Accelerator Lab., Batavia, IL (USA). Jul 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03000. (CONF-8907129–1: NATO advanced research workshop on physics and geometry, 2-8 Jul 1989). Order Number DE89016284/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The evolution of a 4-dimensional heterotic string is considered in the background of its massless excitations such as graviton, antisymmetric tensor, gauge fields and scalar bosons. The compactified bosonic coordinates are fermionized. The world-sheet supersymmetry requirement enforces Thirring-like four fermion coupling to the background scalar fields. The non-abelian gauge symmetry is exhibited through the Ward identities of the S-matrix elements. The spontaneous symmetry breaking mechanism is exhibited through the broken Ward identities. An effective 4-dimensional action is constructed and the consequence of spontaneous symmetry breaking is envisaged for the effective action. 19 refs.

46492 (IC–89/52) **Renormalization group flows in N=2 superconformal models.** Kei Ito. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 8p. Order Number DE89635720/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

We derive the renormalization group flow patterns in the A-D-E classification of N=2 superconformal discrete series, induced by relevant operators (tachyon fields). The flow pattern is consistent with Zamolodchikov's c-theorem. (author). 7 refs.

46493 (IC–89/65) **Off-shell closed strings as the topological open membranes. Dynamical transmutation of world sheet dimension.** Kogan, Y.I. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 9p. Order Number DE89635721/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Using the connection between (2+1) Chern-Simons gauge theory and 2d Conformal Field Theory the on-shell string condition is obtained as a condition of full independence of interior of (2+1) world. The new method for off-shell continuation is considered based on the introduction of the Maxwell term in (2+1) theory. This leads to dynamical transmutation of world-sheet dimensions - the off-shell string becomes topological membrane (topological means that (2+1) theory has topological mass term). The dependence of parameters of (2+1) theory under the external fields is discussed. (author). 17 refs.

46494 (IC–89/71) **Stable supermembrane vacuum with a discrete spectrum.** Duff, M.J.; Pope, C.N.; Sezgin, E. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 9p. (CTP-TAMU–1/89). Order Number DE89635722/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

We examine the massless spectrum of the supermembrane in the background of four-dimensional anti-de Sitter space times a compact internal space, by considering quantisation about a collapsed membrane configuration. We also observe that the vacuum is stable and that the spectrum of massive states is necessarily discrete. In this respect, the supermembrane favours anti-de Sitter over Minkowski space, where the spectrum seems likely to be continuous. (author). 19 refs.

46495 (IC–89/106) **Modular transformations of conformal blocks in WZW models on Riemann surfaces of higher genus.** Miao Li; Ming Yu. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 23p. Order Number DE89635718/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We derive the modular transformations for conformal blocks in Wess-Zumino-Witten models on Riemann surfaces of higher genus. The basic ingredient consists of using the Chern-Simons theory developed by Witten. We find that the modular transformations generated by Dehn twists are linear combinations of Wilson line operators, which can be expressed in terms of braiding matrices. It can also be shown that modular transformation matrices for $g > 0$ Riemann surfaces depend only on those for $g \leq 3$. (author). 13 refs, 15 figs.

46496 (IC–89/108) **Gauge theories of infinite dimensional Hamiltonian superalgebras.** Sezgin, E. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 12p. Order Number DE89635719/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Symplectic diffeomorphisms of a class of supermanifolds and the associated infinite dimensional Hamiltonian superalgebras, H(2M,N) are discussed. Applications to strings, membranes and higher spin field theories are considered: The embedding of the Ramond superconformal algebra in H(2,1) is obtained. The Chern-Simons gauge theory of symplectic super-diffeomorphisms is constructed. (author). 29 refs.

46497 (IN2-P3–89-01, pp. 93-212) **Compactification and phenomenology.** Binetruy, P. (Grenoble-1 Univ., 74 - Annecy (FR). Lab. de Physique des Particules). Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. (CONF-8709294–: 19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics), 7-11 Sep 1987). In *Strings and superstrings. Electron linear colliders.* Order Number DE89903207/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

The compactification process and the effective field theory that emerges at the outcome of compactification are introduced, using compactification of the Calabi-Yau manifolds. Mcomp, the scale typical of compactification (typically by dimensional analysis, the inverse radius of the compact manifold) is introduced. The effective theory is taken from Mcomp down to energies accessible to experiment. In the process, supersymmetry and part of the gauge symmetry are broken, and particles acquire a mass (fields which acquired a mass at the string compactification level are superheavy

and have decoupled). The state of experimentation is summarized, and the prospect of finding new particles is assessed. The connection between string models and particle physics is stressed.

46498 (IN2-P3–89-01, pp. 59-92) **Construction of strings and superstrings in arbitrary space-time dimensions.** Kounnas, C. (Ecole Normale Superieure, 75 - Paris (FR). Lab. de Physique Theorique). Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. (CONF-8709294–: 19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics), 7-11 Sep 1987). In *Strings and superstrings. Electron linear colliders.* Order Number DE89903207/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

String models with space-time chiral fermions and physically relevant interactions may easily be constructed in space-time dimensions lower than ten by using different versions of the underlying two-dimensional superconformal theory. The fundamental string constraints and their general solutions are presented for the case of closed strings in which all the string internal quantum numbers are carried by free periodic and antiperiodic world sheet fermions. We also present a symmetry breaking mechanism, for gauge symmetry and supersymmetry, which operates on the string level. This mechanism defines new string solutions which are characterized by a mass spectrum depending upon several breaking parameters, therefore introducing new arbitrary continuous parameters on strings.

46499 (IN2-P3–89-01, pp. 3-34) **Introduction to string theory.** Alessandrini, V. (Paris-11 Univ., 91 - Orsay (FR). Lab. de Physique Nucleaire et Hautes Energies). Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. (In French). (CONF-8709294–: 19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics), 7-11 Sep 1987). In *Strings and superstrings. Electron linear colliders.* Order Number DE89903207/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Open and closed boson theories are discussed in a classical framework, highlighting the physical interpretation of conformal symmetry and the Virasoro (1970) algebra. The quantification of bosonic strings is done within the old covariant operational formalism. This method is much less elegant and powerful than the BRST quantification, but it quickly reveals the physical content of quantum theory. Generalization to theories with fermionic degrees of freedom is introduced: the Neveu-Schartz (1971) and Ramond (1971) models, their reduced supersymmetry (two dimensions) and the Gliozzi, Scherk and Olive (1977) projection which leads to a supersymmetry theory in the usual meaning of the term.

46500 (IN2-P3–89-01, pp. 35-57) **Strings in interaction.** Schwimmer, A. (Weizmann Inst. of Science Rehovoth (IL). Dept. of Physics). Institut National de Physique Nucleaire et de Physique des Particules, 75 - Paris (France). 1989. (CONF-8709294–: 19. Ecole de Physique des Particules (Gif-sur-Yvette summer school of Particle Physics), 7-11 Sep 1987). In *Strings and superstrings. Electron linear colliders.* Order Number DE89903207/JAW. Available from NTIS (US Sales Only), PC A13/MF A01.

Field theory in the first quantized formalism is introduced. The construction of vertex operators is explained. Interactions of the closed bosonic string are presented.

46501 (INIS-BR–1564) **Model of confinement for quantum chromodynamics in 2+1 dimensions.** Silva Filho, A.C. da. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 106p. (In Portuguese). Order Number DE89635723/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

A dielectric mechanism of QCD in 2 + 1 dimensions is studied. This model yields confinement of two opposite color charges which are infinitely massive, via a linear potential. A functional expression for the dielectric parameter ϵ and studied analitical and numerical the resulting constitutive equations is obtained. A perturbative approach of these yields the non-leading contributions to the asymptotic potential as well for the boundary of the confinement domain. The results obtained for the transversal width of the confinement domain, considering large separations R of color charges, indicate that increases like $R^2$3/, behavior which differs from the one suggested by the string models. (author).

46502 (INIS-SU–108, pp. 12-14) **Gauge-invariant formulation of stochastic quantized nonabelian theory. Counterterm dependence on gauge.** Karnaukhov, S.N.; Subbotin, A.V. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Plasma physics. Collection.* Order Number DE89012206/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 11.

In frames of gauge-invariant formulation of stochastically quantized nonabelian theory calculations of one-loop corrections to two-point distribution functions in $A_5=a\partial_\mu A_\mu$ gauges for arbitrary $a>0$ are carried out. Dependence of one-loop counterterms on gauge parameters, in the given approximation providing for finiteness of all Green functions in nonequilibrium phase is obtained. 5 refs.; 3 figs.

46503 (KEK–88-10, pp. 152-172) **Strong coupling phase in QED.** Aoki, Ken-ichi (Kyoto Univ. (Japan). Research Inst. for Fundamental Physics). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

Existence of a strong coupling phase in QED has been suggested in solutions of the Schwinger-Dyson equation and in Monte Carlo simulation of lattice QED. In this article we recapitulate the previous arguments, and formulate the problem in the modern framework of the renormalization theory, Wilsonian renormalization. This scheme of renormalization gives the best understanding of the basic structure of a field theory especially when it has a multi-phase structure. We resolve some misleading arguments in the previous literature. Then we set up a strategy to attack the strong phase, if any. We describe a trial; a coupled Schwinger-Dyson equation. Possible picture of the strong coupling phase QED is presented. (author).

46504 (NBI-HE–89-24) **A random walk representation of the Dirac propagator.** Ambjoern, J.; Durhuus, B.; Jonsson, T. Niels Bohr Inst., Copenhagen (Denmark). May 1989. 14p. Order Number DE89915283/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

We define a discrete random walk with a matrix valued transition function and show that the scaling limit of the two point function of the walk is given by the Dirac propagator. We study the scaling limit of similar walks with curvature dependent transition functions, which are analogous to the Ornstein-Uhlenbeck process, and show that the Dirac propagator can be recovered by a limiting procedure. (orig.).

46505 (SLAC-PUB–5022) **Three level constraints on conformal field theories and string models.** Lewellen, D.C. Stanford Linear Accelerator Center, Menlo Park, CA (USA). May 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00515. (CONF-8903130–3: Strings '89 conference, 13-18 Mar 1989). Order Number DE89016942/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Simple tree level constraints for conformal field theories which follow from the requirement of crossing symmetry of four-point amplitudes are presented, and their utility for probing general properties of string models is briefly illustrated and discussed. 9 refs.

46506 (UCRL–101586) **General covariance and strings.** Klinkhamer, F.R. Lawrence Livermore National Lab., CA (USA). Jul 1989. 5p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8907129–2: NATO advanced research workshop on physics and geometry, 2-8 Jul 1989). Order Number DE89016505/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

It may be that (super)strings are part of the elusive quantum theory of gravity. If so, one obvious question is whether or not string field theory is generally covariant. Recall that string field theory (for a review see Ref.1) involves the string creation/annihilation operator $\Phi[X]$, where, for brevity, we omit the ghost coordinates. The action of the free open string is $\int DX\ \Phi[X]\ Q\ \Phi[X]$, where $Q = Q(X, \delta/\delta X)$ is the so called BRST operator and $\int DX$ integrates over the space of all strings, i.e., "loop space." Since both DX and Q involve the Minkowski metric $\eta_{\mu\nu}$ the action is clearly not generally covariant.

Actually, we are interested in covariance not only over the finite dimensional "target space" but over the infinite dimensional "loop space." The most straight forward thing to do is to introduce a background loop space metric and to follow, as closely as possible, the steps of standard general relativity. Here I will list the basic results only. 3 refs.

46507 Zamolodchikov metric and effective Lagrangians in string theory. Cveti@/rc@ (Department of Physics, University of Pennsylvania, Philadelphia, Pennsylvania 19104-6396(US)); w, M.; Ovrut, B. A.; Louis, J. *Physical Review [Section] D: Particles and Fields (USA)*, 40(2): 684-687 (15 Jul 1989). DOE Contract AC02-76ER03071;AC03-76SF00515.

Using the (1,0) superspace formalism, we calculate the Zamolodchikov metrics for moduli and 27,27¯ matter scalars in the untwisted sector of (2,2)-symmetric Z_N orbifolds. These metrics are found to be the same as the metrics in the effective Lagrangians of untwisted moduli and matter scalars obtained previously by different methods. This result is strong evidence that the Zamolodchikov metric and the metric on the manifold of scalars in the effective Lagrangian are identical for all string theories.

65 PHYSICS II

Refer also to citation(s) 46425

6510 Nuclear Physics

Refer also to citation(s) 45060, 46540, 46545, 46546

46508 Possible high T_c superconductivity in the Ba-La-Cu-O system. Bednorz, J.G. (IBM Zuerich Research Lab., Rueschlikon (Switzerland)); Mueller, K.A. pp. 1197 of Physics of particle accelerators. Volume 2. Month, M.; Dienes, M. (eds.) American Institute of Physics, New York, NY (1989). (CONF-8808234–Vol.2-Exc.: U.S. Particle Accelerator School: physics of particle accelerators; U.S. Particle Accelerator School, 20 Jul - 14 aug 1987; aug 1988).

The author covers the technology of the new oxide superconductors and how they might relate to the existing superconductors. Replacement of metallic helium-temperature superconductors such as Nb-Ti or Nb_3Sn by high temperature superconductors does not look at all feasible at present. The low transport J_c granular behavior is widely recognized. Disconnected behavior continues to preclude even demonstration magnets. 10 figures, 1 table.

46509 (GSI–89-15) **1.4 decades of 1.4 MeV/u heavy ion beams.** Mokler, P.H. (ed.). Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). May 1989. 255p. Order Number DE89915167/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

This report is a collection of the annual reports from 1976 to 1978 and scientific reports from 1979 to 1988 together with a list of publications and university degrees of the GSI Darmstadt. The work concerns heavy ion reactions, atomic collisions, studies of radiation effects in solids and biology, and detector development. (HSI).

46510 (IAEA-TECDOC–491, pp. 69-72) **Measured dependence of effective cross-sections on thermal neutron temperature.** Okazaki, A. (Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs.); Jones, R.T. International Atomic Energy Agency, Vienna (Austria). Jan 1989. (CONF-8712144–: Advisory group on nuclear data for the calculation of thermal reactor reactivity coefficients, 7-10 Dec 1987). In *Nuclear data for the calculation of thermal reactor reactivity coefficients. Proceedings of an advisory group meeting held in Vienna, 7-10 December 1987.* Order Number DE89635489/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The variation of effective cross sections with temperature of Maxwellian neutron distributions has been measured for fission in U233, U235 and Pu239, and for capture in U238, Th232, Cu63, In115, Lu176 and Au197. Foil activation methods were used. Mn55, which has a 1/v dependence, was used as the reference. The results agree within the estimated uncertainties with the ENDF/B-V data except for Lu176 and Au197. (author). 7 refs, 8 figs.

46511 (IPEN-PUB–249) **Photofission cross sections of U-233 and Pu-239 near threshold induced by gamma-rays from thermal neutron capture.** Moraes, M.A.P.V. de; Cesar, M.T.F. Instituto de Pesquisas Energeticas e Nucleares, Sao Paulo, SP (Brazil). Feb 1989. 23p. Order Number DE89635987/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The photofission cross sections of U-233 and PU-239 have been studied using monochromatic photons produced by thermal neutron capture in several materials placed in a radial beam hole of the IEA-R1, 2 MW pool type research reactor, in the energy interval from 5.43 MeV to 9.72 MeV. The gamma flux incident on the samples were measured using a (3X3) inch. NaI(Tl) crystal. The photofission fragments were detected in MAKROFOL-KG (solid state nuclear track detector) etched 30 min. in a KOH (35%wt) solution at 60^0C. The efficiency of the detector was obtained using a Californium-252 calibrated source and its value was (0.4323 +- 3%). The tracks were counted by means of an automatic spark counting. Analyzing the photofission data we have observed similarities between the cross sections obtained for the two samples in comparison with other authors. A structure was also observed in the U-233 cross section near the energy of 7.23 MeW. Acoording to the liquid drop model the height of the simple fission barrier were determined: (5.6 +- 0.2) MeV and (5.7 +- 0.2) MeV for U-233 and Pu-239 respectively. The relative fissionability of the samples to U-238 were also determined in each excitation energy and showed to be energy independent: (2.12 +-0.25) for U-233, and (3.32+-0.41) for Pu-239. (author).

46512 (ORNL/FTR–2911) **[Medium-energy heavy-ion excitation and photon decay of giant resonances]: Foreign trip report, June 3, 1988–June 12, 1988.** Bertrand, F.E. Oak Ridge National Lab., TN (USA). 20 Jun 1988. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017277/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The traveler presented an invited talk, entitled "Medium-Energy Heavy-Ion Excitation and Photon Decay of Giant Resonances," at the Third International Conference on Nucleus Nucleus Collisions held in Saint-Malo, France, June 6–11, 1988. This excellent conference was attended by over 400 nuclear physicists and provided a varied program in heavy-ion research.

46513 (ORNL/FTR–3191) **[Lifetime of unresolved states]: Foreign trip report, March 6, 1989–March 10, 1989.** Lee, I-Yang. Oak Ridge National Lab., TN (USA). 14 Mar 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017353/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The traveler gave a talk, "Lifetimes of Unresolved States," at the Workshop on Nuclear Structure at High Spins, at Bad Honnef, West Germany. The presentations and discussions at the meeting were on recent results on high-spin nuclear spectroscopy. The European plan for the next generation gamma-ray detector array, Euroball, was also discussed.

6511 Experimental Techniques

Refer also to citation(s) 45824, 46662

6512 Nuclear Properties and Reactions, A=1-5, Experimental

Refer also to citation(s) 45938, 46437

46514 (BONN-IR–88-11) **Development of a vector and tensor polarized deuteron target and measurement of the target asymmetry in the photon-deuteron fission at 450 MeV and 650 MeV photon energy.** Schilling, E.P. Bonn Univ. (Germany, F.R.). Physikalisches Inst.; Bonn Univ. (Germany, F.R.). Mathematisch-Naturwissenschaftliche Fakultaet. Mar 1988. 107p. (In German). Order Number DE89915163/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

High vector- and tensor polarization was achieved with the newly-developed target material deuterated ammonia (ND_3). For the dynamic nuclear polarization (DNP) the material was prepared by irradiation under liquid argon at 90 K with electrons of the Bonn 20

MeV injection Linac. At a magnetic field of 2.5 T and a temperature of 0.2 K we yielded a vector polarization of 0.44. The highest value 0.49 was obtained at 3.5 T after further 'in situ' irradiation during the measurement of spin observables of the deuteron. The corresponding values for the tensor polarization are 0.15 and 0.19. In addition, a method to enhance tensor polarization is introduced. This method bases on the saturation of RF-transitions in the deuteron spin system. The applicance to distinct deuteron spin-flip transitions in a single crystal is very effective. This has been demonstrated with promising results. At the Bonn 2.5 GeV Electron Synchrotron we have measured two angular distributions of the target asymmetry of the reaction $\gamma + d_{\uparrow} \rightarrow p + n$ at photon energies of 450 MeV and 650 MeV and at proton-cm-angles between 25^0 and 155^0. For one kinematical setting also the tensor asymmetry was measured. Proton and neutron were detected in coincidence. Our results are compared with recent analyses. (orig.).

46515 (CONF-8907127–1) **High energy deutron photodisintegration.** Napolitano, J. SLAC NE8 Collaboration. Virginia Univ., Charlottesville, VA (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER40390. From 12. few body conference; 2-8 Jul 1989. Order Number DE89016391/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Results are presented for two-body deuteron photodisintegration, i.e., $d(\gamma,p)n$, at $\theta_{CM} = 90°$ and for photon energies up to 1.6 GeV. These results are discussed in the light of several theoretical models. The data suggest that, at the highest energies, the energy dependence of the cross section is that given by simple constituent counting. We also discuss the need for additional work, both experimental and theoretical, to help resolve conflicting points of view. 4 refs., 4 figs.

6513 Nuclear Properties and Reactions, A=6-19, Experimental

46516 (INIS-SU–109/A, pp. 20-22) **π^+ photoproduction on ^{12}C nucleus with excitaion of ^{12}B nucleus first level.** Adam, I.; Belov, M.V.; Vagner, V. and others. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics*. Order Number DE89012198/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 10.

Differential cross-sections of $^{12}C(\gamma, \pi^+)^{12}B$(0.95 MeV) reactor reaction for 45 and 82 deg angles of pion escape in 70-160 MeV pion energy range were measured. Correlation os experimental data with calculations, conducted in impulse approximation with distorted waves is presented. 14 refs.; 2 figs.

46517 (KFK–4564) **Elastic break-up of 156 MeV ^{6}Li projectiles with large asymptotic relative momenta of the fragments.** Heide, N.; Rebel, H.; Gils, H.J.; Jelitto, H.; Kiener, J.; Wentz, J.; Zagromski, S.; Corcalciuc, V.; Srivastava, D.K. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik. May 1989. 31p. Order Number DE89915143/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The triple differential cross sections for elastic break-up of 156 MeV ^{6}Li projectiles by the reactions ^{208}Pb (^{6}Li, ad) $^{208}Pb_{g.s.}$, and ^{12}C (^{6}Li, ad) $^{12}C_{g.s.}$ have been measured with large asymptotic relative momenta of the outgoing fragments. The data exhibit rather unfamiliar shapes of the energy spectra, often replacing the usual bell-shape distributions by double-peaked structures and varying rapidly with the relative emission angles. The origin of these features has been explored and the cross sections have been analysed on the basis of a diffractive disintegration approach. (orig.).

46518 (KFK–4584) **Nuclear structure effects in elastic ^{12}C + ^{12}C scattering.** Galachmatova, S.; Romanovsky, E.; Shirokova, A.; Shitikova, K.V.; Gils, H.J.; Rebel, H. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik. May 1989. 12p. Order Number DE89915144/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Elastic ^{12}C + ^{12}C scattering cross sections measured at incident energies of 13.8 MeV/amu and of 9.8 MeV/amu are analysed within the semimicroscopic approach of the standard double-folding model. The influence of different forms of the ^{12}C-nucleon density distribution is studied. It turns out that the experimental cross sections give some preference for a density distribution resulting from an α-cluster model description of ^{12}C. (orig.).

46519 (LA–11656-MS) **Differential neutron production cross sections and neutron yields from stopping-length targets for 256-MeV protons.** Meier, M.M.; Amian, W.B.; Goulding, C.A.; Morgan, G.L.; Moss, C.E. Los Alamos National Lab., NM (USA). Aug 1989. 31p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. Order Number DE89015976/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We have measured differential (p,xn) cross sections, $d^2\sigma/d\Omega dE_n$, from thin targets and absolute neutron yields from stopping-length targets at angles of 7.5°, 30°, 60°, and 150° for the 256-MeV proton bombardment of elemental beryllium, carbon, aluminum, and iron. Additional cross-section measurements are reported for oxygen, lead, and ^{238}U. We used time-of-flight techniques to identify and discriminate against backgrounds and to determine the neutron energy spectrum. Comparison of the experimental data with intranuclear-cascade evaporation-model calculations using the code HETC showed discrepancies in the differential cross sections by as much as a factor of 7, notably at 7.5° and 150°, and much better agreement for the stopping-length targets where transport presumably dominates production effects in the calculations. 15 refs., 16 figs., 4 tabs.

6514 Nuclear Properties and Reactions, A=20-38, Experimental

Refer also to citation(s) 46519

46520 (CRN-PN–88-32) **Beta decay of ^{30}Na: experiment and theory.** Baumann, P.; Dessagne, P.; Huck, A.; Klotz, A.; Knipper, A.; Miehe, C.; Ramdane, M.; Walter, G.; Marguier, G.; Gabelmann, H. Strasbourg-1 Univ., 67 (France). Centre de Recherches Nucleaires. 1988. 30p. Order Number DE89908091/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

The ^{30}Na β decay was studied on-line by means of mass-separation techniques. Gamma-ray, gamma-gamma, neutron-gamma spectra, neutron time-of-flight singles and γ-coincidence measurements, were registered. High-energy neutron branches (E_n >2 MeV) were found complementing previouly reported data. A ^{30}Na β-decay scheme to ^{30}Mg bound and unbound states is established. The distribution of the transition strength as a function of the excitation energy for particle-unbound levels in ^{30}Mg is compared to shell-model calculations performed in the 0-12 MeV excitation energy range. An overall renormalization yields a B(GT) quenching factor of 0.28 substantially lower than generally observed in this mass region. Three levels in ^{29}Mg which are strongly populated via the 1n-channel are related to negative parity intruder states.

46521 (INIS-BR–1569) **Studies of elastic scattering and cross sections of the ^{12}C + ^{28}Si system.** Oliveira Junior, J.M. de. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1988. 110p. (In Portuguese). Order Number DE89635990/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

Angular distributions of the elastic scattering of the system $^{12}C+^{28}Si$ were measured at the energies E_{CM} = 14.70; 16.08; 18.90; 20,97; 21.87 MeV, in the angular range $15^0 \leq \theta_{CM} \leq 170^0$, with angular steps of 1^0. Other seven angular distributions measured by Villari, Ost and Cheng at energies E_{CM} = 17.50; 19.60; 20.30; 22.40; 23.80; 24.50 and 25.20 MeV, have also been used in our analysis. The angular distributions have been reproduced by optical model calculations and new optical potentials for the system $^{12}C+^{28}Si$ were obtained. Calculations of the total reaction cross section from the elastic scattering data using a model independent method were done. The results were compared with fusion cross section data and with total reaction cross sections obtained via optical model calculations. Finally experimental angular distributions were analysed by phase shift analysis and the problem of unicity and ambiguities of the scattering matrix S(l) was discussed. (author).

46522 (INIS-BR–1595) **Experimental investigation of quadrupole virtual photon spectrum.** Gouffon, P. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 99p. (In Portuguese). Order

Number DE89635991/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

To test experimentally the quadrupole virtual photon spectrum calculation, the (e,α) excitation function of an isolated 2^+ level at 20.14 MeV in ^{24}Mg was measured. The most recent calculations in DWBA, including nuclear size effects, are compared to this experimental curve. The differential cross section $d^2\sigma/d\Omega dE$ was measured 48^0, 90^0, 132^0 in the laboratory system, for total electron energies of 20.0, 20.8, 21.5, 24.0, 26.0, 28.0, 30.0, 32.0, 36.0, and 40.0 MeV. The reduced matrix element B(E2) of the 20,14 MeV level is extracted as a secondary product of this work. (author).

46523 (INIS-SU–78, pp. 293-297) **Measurement of thermal cross section for the ^{36}Cl(n,p)^{36}S reaction.** Vertebnyj, V.P. (AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij); Grebnev, A.V.; Pshenichnyj, V.A.; Andzhevski, Yu.; Gledenov, Yu.M.; Zvarova, T.S.; Mitrikov, M.P.; Popov, Yu.P.; Salatskij, V.I.; Zuan, V.Z. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); AN SSSR, Moscow (USSR); AN Ukrainskoj SSR, Kiev (Ukrainian SSR). Inst. Yadernykh Issledovanij. 1988. (In Russian). (CONF-870959–: 1. international conference on neutron physics, 14-18 Sep 1987). In *Neutron physics. Vol. 2.* Order Number DE89012115/JAW. Available from NTIS (US Sales Only), PC A16/MF A01; INIS.

The thermal cross section of the (n,p) reaction on the radiactive nucleus ^{36}Cl was measured for the first time. The ionization chamber with two grids was used for identification and spectrometry of low-energy protons. The thermal cross section is found to be equal to (0.4+-0.1) b. 5 refs.; 2 figs.

46524 Small angle correlations in low energy heavy ion reactions: Emission time scales. Gordon, M. (SUNY, Stony Brook (USA)); Gilfoyle, G.P.; Xiuqin Lu; de Castro Rizzo, D.M.; Auger, G.; Kox, S.; Vax, L.C.; Alexander, J.M.; McGrath, R.L.; DeYoung, P.A.; Gelderloos, C.J.; Kortering, D.; Sarafa, J.; Kovar, D.G.; Vineyard, M.F.; Beck, C. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

Light particles (p, d, α) have been studied (both singles and two-fold coincidences) from the reactions 80, 140, and 215 MeV ^{16}O + ^{27}Al. Singles data indicate evaporation-like emission for laboratory angles greater than about 50° (lab). Small angle correlations measured here of p-p (at the lower two energies), p-d, and d-d suggest long-range Coulomb forces dominate the interactions. Comparison to a trajectory model implies particle emission times of a few x 10^{-21} s at 140 MeV. In contrast, p-α, d-α, and α-α correlations have peaks associated with the short-range nuclear force. By comparing coincidence yields for detector pairs having $\Delta\phi \approx 0$ and $\approx 180°$ azimuthal separation, and by exploiting compound nucleus decay symmetries, we argue these latter correlations are due to decay of preformed, metastable resonances and are therefore insensitive to lifetime effects. All correlations become stronger with increasing energy.

6515 Nuclear Properties and Reactions, A=39-58, Experimental

Refer also to citation(s) 46519

46525 (DOE/ER/40326–9) **Neutron cross section measurements using the Oak Ridge electron linear accelerator: Performance report, July 1988–July 1989.** Winters, R.R.; Hicks, J.L. Jr. Denison Univ., Granville, OH (USA). Aug 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER40326. Order Number DE89015615/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report discusses: n + ^{40}Ar reactions; Neutron transmission measurement of n + ^{86}Kr; state dependence of the optical potential ^{189}Os and the s-process of stellar nucleosynthesis; and ^{122,123,124,124,126}Te + n reactions. 4 refs., 9 figs. (LSP)

6516 Nuclear Properties and Reactions, A=59-89, Experimental

Refer also to citation(s) 46525

46526 (KEK–88-10, pp. 276-280) **Future perspective of double beta decay.** Takasugi, E. (Osaka Univ., Toyonaka (Japan). Coll. of General Education). National Lab. for High Energy Physics, Tsukuba, Ibaraki (Japan). Dec 1988. (CONF-8805324–: 2. meeting on physics at TeV energy scale, 23-25 May 1988). In *Proceedings of the second meeting on physics at TeV energy scale.* Order Number DE89906400/JAW. Available from NTIS (US Sales Only), PC A16/MF A01.

The double beta decay is a quite useful tool to explore the nature of neutrino, but also powerful to explore the nature of particles which are hard to be explored by other experiments. One of the example is the exploration of the mass of Zino which is the superpartner of Z. I discuss how to achive this in the double beta decay experiment. Also I discuss the recent development of the double beta decay both from theoretical and experimental view point. (author).

6517 Nuclear Properties and Reactions, A=90-149, Experimental

Refer also to citation(s) 46525, 46526, 46534, 46536

46527 (INIS-mf–11503, pp. 4-6) **Studies of rare earth delayed proton emitters at OASIS.** Gilat, J. (Israel Atomic Energy Commission, Yavne (Israel). Soreq Nuclear Research Center). Israel Nuclear Society, Yavne (Israel). Mar 1989. (CONF-8903152–: Nuclear Societies of Israel annual meeting, 13 Mar 1989). In *Annual Meeting 1989.* Order Number DE89012204/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Transactions.; V. 15.

'short communication.'

46528 (INP–1302/PS, pp. 187-198) **Beta-delayed proton and gamma-decay of the N=81 isotones ^{147}Dy and ^{149}Er.** Schardt, D. (Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.)); Larsson, P.O.; Kirchner, R. and others. Institute of Nuclear Physics, Cracow (Poland). 1985. (CONF-8504342–: 20. winter school on physics, 13-26 Apr 1985). In *Selected topic in nuclear structure. V. 1. Proceedings of 20 winter school, 13-26 April 1985, Zakopane, Poland.* Order Number DE89632395/JAW. Available from NTIS (US Sales Only), PC A19/MF A01 - OSTI; INIS.

Recent results from β-delayed proton and γ-decay studies of the N=81 precursors ^{147}Dy and ^{149}Er are presented. Proton emission proceeds from highly excited states in the N=82 β-decay daughters ^{147}Tb and ^{149}Ho to the ground-states of ^{146}Gd and ^{148}Dy, respectively. First results on overlapping proton and γ-ray spectroscopy, i.e. observation of competitive deexcitation of high-lying levels by proton and γ-ray emission are discussed for ^{147}Dy. Our results for ^{149}Er include the identification of the $\nu h_{11}2/^{-1}$M4 isomer and the five low-lying proton single particle states in the β-decay daughter ^{149}Ho. 13 refs., 8 figs. (author).

46529 (ORNL–6561) **Neutron capture of ^{122}Te, ^{123}Te, ^{124}Te, ^{125}Te, and ^{126}Te.** Macklin, R.L.; Winters, R.R. Oak Ridge National Lab., TN (USA). Jul 1989. 40p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015682/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Isotopically enriched samples of the tellurium isotopes from mass 122 to mass 126 were used to measure neutron capture in the energy range 2.6 keV to 600 keV at the Oak Ridge Electron Linear Accelerator pulsed neutron source. Starting at 2.6 keV, over 200 Breit-Wigner resonances for each isotope were used to describe the capture data. Least-squares adjustment gave parameters and their uncertainties for a total of 1659 resonances. Capture cross sections averaged over Maxwellian neutron distributions with temperatures ranging from kT = 5 keV to kT = 100 keV were derived for comparison with stellar nucleosynthesis calculations. For the three isotopes shielded from the astrophysical r-process, ^{122}Te, ^{123}Te and ^{124}Te at kT = 30 keV the respective values were (280 $\pm$ 10) mb, (819 $\pm$ 30) mb and (154 $\pm$ 6) mb. The corresponding products of cross section and solar system abundance are nearly equal in close agreement

with s-process nucleosynthesis calculations. 26 refs., 8 figs., 10 tabs.

46530 Nuclear shapes from charged-particle γ-ray angular correlations. Nicolis, N.G. (Washington Univ., St. Louis, MO (USA)); Griffin, H.C.; Sarantites, D.G.; Adler, L.; Majka, Z.; Sobotka, L.G.; Semkow, T.M.; Beene, J.R.; Halbert, M.L.; Hensley, D.C.; Natowitz, J.B.; Schmitt, R.P.; Fabino, D.; Nebbia, G.; Mouthaty, G. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

Alpha-particle and proton-angular distributions with respect to the spin direction have been measured following heavy ion fusion reactions. The energy dependence of the associated anisotropies systems studied were ^{110}Sn (94 MeV), ^{114}Sn (80 MeV), ^{138}Nd (82 MeV), ^{164}Yb (67 MeV), and ^{174}Yb (135 MeV). Distinct differences were found between these systems, suggesting near spherical behavior for the Sn systems, smaller deformations for ^{164}Yb and ^{138}Nd, and larger deformation for ^{174}Yb. These trends are compared with similar results from giant dipole resonances built on excited states. Recent results of proton spectra leading to superdeformed ^{148}Gd states observed in a 4π arrangement will be discussed.

46531 Complex fragments emitted in particle-stable states for the ^{32}S+^{nat}Ag reaction at E/A=22.3 MeV. Xu, H. M. (Department of Physics and Astronomy, Department of Chemistry, and National Superconducting Cyclotron Laboratory, Michigan State University, East Lansing, Michigan 48824(US)); Lynch, W. G.; Gelbke, C. K.; Tsang, M. B.; Fields, D. J.; Maier, M. R. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(1): 186-210 (Jul 1989). DOE Contract AC05-84OR21400.

The emission of complex fragments was studied for ^{32}S-induced reactions on ^{nat}Ag at E/A=22.3 MeV for angles back of the grazing angle, θ_{IMF}=20°–50°. The measured fragment kineticenergy spectra peak at energies near the exit channel Coulomb barriers anddecrease exponentially at higher energies. The angular distributions areforward peaked, indicating emission prior to the attainment of full statisticalequilibrium of the composite system. The relative populations of a large numberof particle stable states of these fragments were measured with a spinspectrometer. Comparisons with statistical calculations which include feedingfrom known discrete particle unbound states and high-lying continuum statesindicate emission temperatures of about 3–4 MeV.

6518 Nuclear Properties and Reactions, A=150-189, Experimental

Refer also to citation(s) 46525, 46530

46532 (GANIL-P–88-14) **Observation of new neutron rich nuclei ^{29}F, ^{35}Mg, ^{36}Mg, ^{38}Al, ^{39}Al, ^{40}Si, ^{41}Si, ^{43}P, ^{44}P, ^{45}S, ^{47}S, ^{46}Cl, ^{49}Cl and ^{48}Ar, ^{51}Ar from the interactions of 55 MeV/u ^{48}Ca + Ta.** Guillemaud-Mueller, D.; Anne, R.; Bazin, D.; Detraz, C.; Guerreau, D.; Jiang, D.X.; Mueller, A.C.; Saint-Laurent, M.G.; Borrel, V.; Jacmart, J.C. Grand Accelerateur National d'Ions Lourds (GANIL), 14 - Caen (France). 1988. 10p. Order Number DE89908210/JAW. Available from NTIS (US Sales Only), PC A02/MF A01.

After magnetic separation, identification through time of flight and δE x E measurements has allowed the observation of the new nuclei, ^{29}F, ^{35}Mg, ^{36}Mg, ^{38}Al, ^{39}Al, ^{40}Si, ^{41}Si, ^{43}P, ^{44}P, ^{45}S, ^{46}S, ^{47}S, ^{46}Cl, ^{47}Cl, ^{48}Cl, ^{49}Cl, ^{49}Ar, ^{50}Ar ^{51}Ar from the interaction of a ^{48}Ca beam of 55 MeV/u with tantalum targets.

46533 Nuclear structure at moderate temperature. Holzmann, R. (GSI, Darmstadt (Germany, F.R.)). pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

Over the last years the properties of nuclei with A $\approx$ 150 have been studied extensively in discrete-line γ-ray spectroscopy as a function of both spin and ground-state deformation. Conversely, the evolution of nuclear structure with changing temperature remains largely unexplored. Hot nuclei provide opportunities to investigate new facets of physics, like shape changes, thermal shape fluctuations and the melting of shell effects. These phenomena, manifestations of a phase transition, are best accessible through measurements of the γ-ray quasicontinuum. This talk will present a study of the continuum properties of ^{152,154,156}Dy done at the Argonne-Notre Dame γ-ray facility. The three nuclei display a pronounced E2 component, which shows in ^{154}Dy an unexpected splitting into two parts, signifying a structural change along the γ-cascade at moderate temperature. Most of the observed features can be reproduced in statistical model calculations.

46534 Heavy-ion induced transfer reactions as a probe of high-spin collective states in nuclei. Cline, D. (Univ. of Rochester, NY (USA)). pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

Strong collective excitation inherent to heavy-ion reactions implies that one and two nucleon transfer can be induced between high-spin collective states. Studies using Ni, Sn and Pb beams with Sn, Dy and U targets have shown: (1) transfer reactions comprise a major fraction of the reaction cross section near the Coulomb barrier; (2) these reactions populate states to spin 30 in the yrast domain of the product nuclei, providing a means of populating high-spin states in transuranic nuclei unperturbed by the fission decay channel; (3) the coincident deexcitation gamma spectra are clean; (4) two-neutron transfer to the ground band exhibits an oscillatory dependence on separation distance and is enhanced by up to a factor of 500 at the largest separation distances. The feasibility of studying single-particle and pairing degrees of freedom at high spin and nuclear analogs of solid-state pairing effects will be discussed.

46535 Doorway-state formation and structure in β-delayed proton decay. Nitschke, J. M. (Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720 and Oak Ridge National Laboratory, Oak Ridge, Tennessee 37831(US)); Wilmarth, P. A.; Firestone, R. B.; Moller, P.; Toth, K. S.; Gilat, J. *Physical Review Letters (USA)*, 62(24): 2805-2808 (12 Jun 1989). DOE Contract AC03-76SF00098;AC05-84OR21400.

The structure in the β-delayed proton spectra of the precursors $^{1}_{66}{}^{47}$Dy^{g}, $^{1}_{68}{}^{49}$Er^{g}, and $^{1}_{70}{}^{51}$Yb^{g} is analyzed within the framework of a doorway-state model. Indications from γ-ray decay studies, β strength-function measurements, and calculations of state densities and Gamow-Teller strength distributions, lead us to suggest that some of the observed proton transitions arise from the preequilibrium decay of doorway states populated in β^+ decay or electron capture.

6519 Nuclear Properties and Reactions, A=190-219, Experimental

Refer also to citation(s) 46517, 46519, 46525

46536 Gamma decay studies of giant resonances. Beene, J.R. (Oak Ridge National Lab., TN (USA)). pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). DOE Contract AC05-84OR21400. (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

Experiments on γ decay of GR in ^{208}Pb, ^{209}Bi, and ^{90}Zr excited by inelastic scattering of 22 and 84 MeV/nucleon ^{17}O will be reviewed. Nuclear structure information obtained from decays to the ground state (γ_0) and low lying excited states will be discussed, and processes contributing to γ_0 emission considered. At 84 MeV/nucleon, Coulomb excitation of GR is significant, enabling isovector resonances to be excited strongly, and providing a sensitive probe of the neutron-proton character of predominantly isoscalar resonances via Coulomb-nuclear interference. Ground state γ coincidence information is important in constraining the decomposition of singles data into individual resonances. The properties of the isovector quadrupole resonance in ^{208}Pb obtained from ^{17}O-γ-γ coincidences will be discussed.

46537 Transfer reactions with heavy deformed nuclei. Landowne, S. (Argonne National Lab., IL (USA)); Price, C.; Esbensen, H. pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). DOE Contract W-31-109-ENG-38. (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

Transfer reactions induced with heavy deformed nuclei depend, in principle, on particle correlations in nuclear systems that are rotating with significant amounts of angular momentum. As such, they are unique probes of nuclear structure. These types of reactions are also, in general, very difficult to measure and to analyze, which accounts for the fact that little research has been carried out on them, either experimentally or theoretically. During the last year new ideas and techniques have been developed which open up this field on the theoretical side, allowing detailed calculations to be carried out. For example, the reaction ^{162}Dy (^{208}Pb, ^{210}Pb)^{160}Dy has been modeled for bombarding energies above the Coulomb barrier. Differential cross sections are calculated for members of the ground state rotational band up to the spin I = 26^{+} state. The characteristic features of such reactions will be discussed, as well as applications to the diabolic transfer process and to cases that involve collisions of two heavy deformed nuclei.

6520 Nuclear Properties and Reactions, A=220 and Above, Experimental

Refer also to citation(s) 46519, 46534

6530 Nuclear Theory

Refer also to citation(s) 45835, 46474, 46512, 46535

46538 (AD-A-208071/1/XAB) **Proof of the feasibility of coherent and incoherent schemes for pumping a gamma-ray laser. Quarterly technical progress report, 1 January-31 March 1989.** Collins, C.B. Texas Univ., Richardson, TX (USA). Center for Quantum Electronics and Applications. Apr 1989. 69p. (GRL-8804). Available from NTIS, PC A04/MF A01.

Recent approaches to the problem of the gamma-ray laser have focused upon up-conversion techniques in which metastable nuclei are pumped with long-wavelength radiation. At the nuclear level the storage of energy can approach tera-Joules 10^{12} per liter for thousands of years. This report focuses on an approach to the gamma-ray laser that depends upon incoherent pumping. This nuclear analog of the ruby laser embodies the simplest concept for a gamma-ray laser and it is not surprising that the greatest rate of achievement toward a sub-Angstrom laser has continued in this direction. Emphasis has remained upon the giant pumping resonances that enabled dumping populations of the only available sample of the 29 candidates, Ta 180_m, through a cross section that was 10,000 times more favorable than even the most optimistic estimates. The lessons taught by that major milestone have been extended throughout the region of mass-180 nuclides. Reported is the success in pumping of only two of the candidates that are accidentally available, together with 17 other comparison isomers with the bremsstrahlung x rays from a MeV linac. Previous excitations of the giant resonances pumping these materials had been made with a continum of photon energies reaching to 6 MeV and concern had lingered that the full 6 MeV of energy might have been actually needed. At such values the density of nuclear states is high and the onset of evaporation of particles from nuclei is near. Either would make the resonances useless to laser development. The significance of this work is that neither detrimental effect can occur at energies as low as the value of 4 MeV at which performance has now been achieved.

46539 (CONF-890583-3) **Monte Carlo studies of nuclei and quantum liquid drops.** Pandharipande, V.R.; Pieper, S.C. Argonne National Lab., IL (USA). 1989. 12p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From Symposium on the occasion of the 40th anniversary of the nuclear shell model; 25-27 May 1989. Order Number DE89016914/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The progress in application of variational and Green's function Monte Carlo methods to nuclei is reviewed. The nature of single-particle orbitals in correlated quantum liquid drops is discussed, and it is suggested that the difference between quasi-particle and mean-field orbitals may be of importance in nuclear structure physics. 27 refs., 7 figs., 2 tabs.

46540 (CONF-890826-1) **Low-energy heavy-ion reactions: Some recent developments.** Satchler, G.R. Oak Ridge National Lab., TN (USA). [1989]. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International nuclear physics conference; 20-26 Aug 1989. Order Number DE89016850/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We address three areas: behavior of the optical model at low energies and associated phenomena, fusion at near- and sub-barrier energies; where does fusion occur?, and recent examples of explicit coupled-channels effects at low energies. 74 refs., 18 figs.

46541 (CONF-890826-2) **Giant resonances: Progress, new directions, new challenges.** Bertrand, J.R.; Beene, J.R. Oak Ridge National Lab., TN (USA). 1989. 40p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From International nuclear physics conference; 20-26 Aug 1989. Order Number DE89017243/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A review of some recent developments in the field of giant multipole resonances is presented. Particular emphasis is placed on directions that the authors feel will be followed in this field during the next several years. In particular, the use of high-energy heavy ions to excite the giant resonances is shown to provide exciting new capabilities for giant resonance studies. Among subjects covered are: Coulomb excitation of giant resonances, photon decay of giant resonances, the recent controversy over the identity of the giant monopole resonance, the most recent value for incompressibility of nuclear matter from analysis of giant monopole data, the isospin character of the 63 $A^{-1/3}$ GQR, agreement between (e,e') and (hadron, hadron') excitation of the giant quadrupole resonance, prospects for multiphonon giant resonance observation, and isolation of the isovector giant quadrupole resonance. 55 refs., 23 figs., 4 tabs.

46542 (CONF-8905156-3) **A dynamical model of pion photoproduction on the nucleon and its applications.** Lee, T.-S.H. Argonne National Lab., IL (USA). [1989]. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract W-31109-ENG-38. From International Centre for Theoretical Physics conference; 22-26 May 1989. Order Number DE89016915/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

A dynamical model of pion photo-production on the nucleon is presented. Its extension to higher energies and application in the study of d(γ,p)n are discussed. 4 refs., 4 figs.

46543 (CONF-8908129-1) **Heavy-ion scattering near the Coulomb barrier: Some recent developments.** Satchler, G.R. Oak Ridge National Lab., TN (USA). [1989]. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 12. workshop on nuclear physics; 28 Aug - 1 sep 1989. Order Number DE89016849/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This paper discusses heavy-ion scattering near the Coulomb barrier with threshold anomalies and discusses the optical model for fusion. 37 refs., 18 figs. (LSP)

46544 (DOE/ER/40048-223-L9) **Fission Isomers.** Vandenbosch, R. Washington Univ., Seattle, WA (USA). Nuclear Physics Lab. [1989]. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-81ER40048. Order Number DE89017318/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The single particle (shell) effects giving rise to spontaneously fissioning shape isomeric states are outlined. Empirical data on static properties such as excitation energies and barrier heights are reviewed and compared with potential energy surface calculations. Half-life and branching ratio information are related to barrier penetration. Spectroscopic information on moments of inertia, quadrupole moments, spins and g-factors are reviewed. Recent developments on shape isomerism in other regions of the Chart of the Nuclides are presented. 22 refs., 5 figs.

46545 (DOE/ER/40048-225-L9) **Nuclear fission: What have we learned in 50 years?.** Vandenbosch, R. Washington Univ., Seattle, WA (USA). 1989. 22p. Sponsored by U.S. DOE Energy

Research. DOE Contract AC06-81ER40048. (CONF-890491--8: International conference on fifty years of research in nuclear fission, 3-7 Apr 1989). Order Number DE89017310/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Nuclear fission has captured the imagination of chemists and physicists for half a century now. There are several reasons for this. One of course is that it represents the most drastic rearrangement of nuclear matter known, challenged only recently by collisions induced by very heavy ions. Another is that both statistical and dynamical features come into play. Perhaps one of the most compelling reasons is its never-ending capacity to surprise us: asymmetric mass distributions, the sawtooth dependence of neutron yields in fragment mass, spontaneously fissioning isomers and intermediate structure resonances. Finally, and perhaps most importantly, fission is a rich laboratory within which one can explore the delicate interplay between the macroscopic aspects of bulk nuclear matter and the quantal effects of a finite number of Fermions. It will of course be impossible for me to cover all aspects of fission. I have chosen a limited number of topics to cover, with particular topics being chosen either because the have been associated with persistent puzzles in fission or because they have, or hopefully will, tell us something special about how nuclei behave. After a brief historical note, I organize these topics sequentially according to the various stages of the fission process, starting first with the probability for fission to occur and ending with scission phenomena. 56 refs., 11 figs.

46546 (DOE/ER/40316--3) **Studies of complex fragment emission in heavy ion reactions: Progress report, September 1, 1988 through August 31, 1989.** Sobotka, L.G. Washington Univ., St. Louis, MO (USA). Dept. of Chemistry. [1989]. 44p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER40316. Order Number DE89016470/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The production of large fragments, fragments with mass between light particles and fission fragments, in intermediate and high energy nuclear reactions has fostered the proposal of a number of novel reaction mechanisms. These include liquid-vapor equilibrium and nuclear shattering. Temporarily left in the wake of these exciting proposed mechanisms was the old standard, statistical decay of compound nuclei. To be sure, the standard treatment of compound nucleus decay did not deal with large fragment production. However, this omission was not due to any fundamental deficiency of statistical models, but rather an uncertainty concerning exactly how to splice large fragment emission into statistical models. A large portion of our program deals with this problem. Specifically, by studying the yields of large fragments produced in sufficiently low energy reactions we are attempting to deduce the asymmetry and l-wave dependence of large fragment emission from compound nuclear intermediates. This, however, is only half of the problem. Since the novel mechanisms proposed for large fragment emission were spawned by intermediate and high energy reaction data, we must also realize the relevance of the compound nucleus mechanisms at high energies. It is not unreasonable to suspect that compound nucleus-like objects are formed with less than complete momentum transfer and perhaps less than complete mass transfer. Therefore the study of energy, mass, and angular momentum transfer in incomplete fusion and non-compound reactions. This thread joins the apparently divergent subjects covered in this report.

46547 (DOE/ER/40334--4) **Nuclear excitations and reaction mechanisms: Progress report, [1 August 1988--31 July 1989].** Fallieros, S.; Levin, F.S. Brown Univ., Providence, RI (USA). Dept. of Physics. 1 Aug 1989. 15p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER40334. Order Number DE89016573/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

This Progress Report describes the work of the Brown University Nuclear Theory Group for the period 1 August 1988--31 July 1989 under Grant FG02-87ER40334. Completed and on-going research includes various theoretical and numerical studies on: virtual photons, electric polarizability, the Cabibo-Radicati sum rule, photon scattering, electron scattering, electron scattering sum rules, muon catalyzed fusion, few body collisions and breakup phenomena. Since it accompanies the three-year Renewal Proposal of the Group, it goes into more detail than our typical one-year reports.

46548 (GSI--89-16) **The role of the viscosity in the hydrodynamic model of high-energetic heavy ion reactions.** Schmidt, W. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.); Frankfurt Univ. (Germany, F.R.). May 1989. 119p. (In German). Order Number DE89915118/JAW. Available from NTIS (US Sales Only), PC A06/MF A01.

In the framework of the study of the properties of strong interactions by means of the thermodynamics of strongly compressed and highly excited nuclear matter as it is produced in relativistic heavy-ion reaction the author considers the hydrodynamic model for such reactions. The viscosity and the thermodynamic properties are derived by means of quantum statistical mechanics. Then the transverse-momentum and rapidity distributions are calculated in this framework. Some calculational results are presented for Au+Au collisions at 200 MeV/N and 400 MeV/N are presented. (HSI).

46549 (GSI--89-50(prepr.)) **The nuclear equation of state in effective relativistic field theories and pion yields in heavy-ion collisions.** Schoenhofen, M.; Cubero, M.; Gering, M.; Sambataro, M.; Feldmeier, H.; Noerenberg, W. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Jun 1989. 35p. Order Number DE89915141/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Within the framework of relativistic field theory for nucleons, deltas, scalar and vector mesons, a systematic study of the nuclear equation of state and its relation to pion yields in heavy-ion collisions is presented. Not the compressibility but the effective nucleon mass at normal nuclear density turns out to be the most sensitive parameter. Effects from vaccum fluctuations are well modelled within the mean-field no-sea approximation by self-interaction terms for the scalar meson field. Incomplete thermalization in the fireball may be the reason for the low pion yields observed in heavy-ion collisions. (orig.).

46550 (GSI--89-52(prepr.)) **The independent quark-gluon string model for heavy-ion collisions at ultrarelativistic energies.** Toneev, V.D.; Amelin, N.S.; Gudima, K.K. Gesellschaft fuer Schwerionenforschung m.b.H., Darmstadt (Germany, F.R.). Jun 1989. 17p. Order Number DE89915140/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

A dynamical model of independent quark-gluon strings is formulated for ultrarelativistic nuclear collisions. The formation and fragmentation of the strings are described in terms of the dual parton model. The consideration of the nuclear interaction is based on a coupled system of relativistic Boltzmann-like kinetic equations including the concept of the hadron formation time. The evolution of energy and baryonic densities is discussed for central O+Au collisions. The calculated characteristics for both the central and fragmentation rapidity region are compared with the recent CERN experimental data to disentangle the contributions of different nuclear effects. (orig.).

46551 (INDC(CSR)--016/LJ) **PEQAG: A PC version of fully pre-equilibrium computer code with gamma emission.** Betak, E. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jun 1989. 26p. Order Number DE89635977/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This work has been performed under IAEA CRP on "Development of Improved Formalism in the Frame of Pre-equilibrium/compound Nuclear Reaction Theory and Code for Particle and Gamma Emission Spectra at Medium Excitation Energies" and research contract No. 5148/RB.

A PC version for exciton model calculation of angle-integrated nucleon and γ energy spectra is presented. All the emissions are treated consistently within the pre-equilibrium approach based on the master equations of the model and multiple particle and/or multiple γ emissions are included. 11 refs.

46552 (INDC(GDR)--054/LJ) **Statistical multistep reactions: application.** Kalka, H.; Torjman, M.; Seeliger, D. International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jun 1989. 33p. Order Number DE89635978/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Work was performed under Research Agreement in the frame of the IAEA CRP on Methods for the Calculation of Fast Neutron Nuclear Data for Structural Materials of Fast and Fusion Reactors.

A model for statistical multistep direct and multistep compound reactions is presented. It predicts (double-differential) neutron and proton spectra including equilibrium, preequilibrium, direct (collective and non-collective) as well as multiple particle emission processes. Calculations for nucleon-induced reactions has been performed for about 30 nuclei at incident energies between 5 and 26 MeV without any parameter fit. (author). 48 refs, 9 figs, 1 tab.

46553 (INDC(NDS)–215/LJ) **Nuclear data for structural materials of fission and fusion reactors. Summary of the second research coordination meeting on methods for the calculation of fast neutron data for structural materials held in Vienna, 15-17 February 1988.** Goulo, V. (ed.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. Jun 1989. 27p. Order Number DE89635979/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The document presents the status of nuclear reaction theory concerning optical model development, level density models and pre-equilibrium and direct processes used in calculation of neutron nuclear data for structural materials of fission and fusion reactors. 6 refs.

46554 (INIS-BR–1562) **Solitons in Gross-Pitaevskii equation.** Lopes, E. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1985. 61p. (In Portuguese). Order Number DE89635967/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

It is observed that, when the potential is integrable and repulsive, the Gross-Pitaevskii Equation, with non-vanishing boundary conditions, describes a family of planar solitons. A method is presented which provides an exact soliton field to the Dirac Delta potential and an approximation solution to any other kind of potential. As an example the method is then applied to the case of a repulsive Yukawa potential. A brief discuss the relation between these solitons and Anderson's superfluidity mechanism, is also presented. (author).

46555 (INIS-BR–1563) **Semiclassical treatment of correlation energy for nuclear systems.** Nielsen, M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1988. 137p. (In Portuguese). Order Number DE89635968/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

Starting with the separation of the many-body density operator in two parts, one describing the one-body aspects of the full density and the other containing all dynamic correlations information, the semiclassical approximation for the system correlation energy, was calculated. It is shown that, in this case, the Gaussian Wave Packets Phase Space Representation is more convenient than the Wely-Wigner Rrepresentation for the analysis of the semiclassical correlation energy. Using a phenomenological interaction, the correlation energy to the nuclear matter and some simmetric finite nucleus was calculated. The Fermi Surface Diffusivity, was also calculated. Finally, from the relation between this theory and the pertubation theory, we have done some considerations about the viability on the local densities expansion for energy functionals. (author).

46556 (INIS-BR–1565) **Symplectic collective model and its submodels.** Santos Avancini, S. dos. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 129p. (In Portuguese). Order Number DE89635969/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

A review the symplectic collective model (SCM), emphasizing the mathematical and physical content of the model is done. Since the SCM is not computationally viable, a detailed discussion of the properties and relationships of the SCM submodels both, in a spherical and in a deformed harmonic oscillator basis is presented. It is shown that the deformed basis is an optimal one, from an analysis of the variational models, variation before projection (VBP) and variation after projection (VAP). To demonstrate that a calculation in the deformed basis is feasible, the submodel Sp paral. (1,R) x Sp perpend. (1,R) to calculate matrix elements of the operators of physical interest in ^{8}Be is considered. The Sp (1,R) x Sp_1 (1,R) is the simplest submodel which contains the states of VBP and VAP. (author).

46557 (INIS-BR–1568) **Determination of kinetic coefficients for proton-nucleus collisions at high energy.** Rizzato, C.M. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1987. 64p. (In Portuguese). Order Number DE89635980/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

From the effective proton dynamics, the approximations in the context of high energy collisions which lead to the Boltzmann equation, are established. From this equation, general expressions for the kinetic coefficients are deduced. Using a simple model, analytical expressions for kinetic coefficients are obtained. The importance of the effect of Pauli blocking is also shown. (author).

46558 (KFK–4565) **A prior-form distorted wave Born approximation analysis of the elastic break-up of 156 MeV ^{6}Li projectiles.** Srivastava, D.K.; Rebel, H.; Heide, N. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Kernphysik. Jun 1989. 37p. Order Number DE89915122/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

Features of the prior-form distorted wave Born approximation theory of elastic break-up of 156 MeV ^{6}Li ions scattered off ^{208}Pb are investigated. Nuclear breakup for large relative energies of the outgoing α-particle and deuteron fragments ($E_{\alpha d}$>5 MeV) studied here is found to proceed dominantly via the quadrupole scattering state of the α+d system when transition potentials from elastic fragment-target scattering are used for the calculations. The coherent contributions of different multipole components to the triple differential cross-sections appear to be very sensitive to the potentials generating the distorted waves and representing the cluster fragment-target interactions. The results of the analysis of the experimental data require transition potentials rather different from the on-the-mass shell optical potentials deduced from elastic α-particle and deuteron scattering. (orig.).

46559 (KFKI–1989-18/A) **Liquid layer model for non-magic nuclei.** Bastrukov, S.I.; Kluge, Gy.; Tarakanov, A.V. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. Mar 1989. 20p. Order Number DE89635970/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A liquid layer model (LLM) is developed for studying the low-energy oscillations of non-magic spherical nuclei. It is assumed that at low excitations only nucleons off the double-magic core take part in the collective motion. These nuclear states are modellized by the motion of a layer of homogeneously charged, incompressible, isotropic liquid around a solid, inert core. Inertia, stiffness and energies of the lowest quadrupole, octupole and hexadecapole excitations are calculated. A fairly good agreement between the calculated and experimental values are obtained in the validity regions of LLM, that is for near magic nuclei. (author) 29 refs.; 5 figs.

46560 (KFKI–1989-26/A) **On prompt fission neutrons.** Kluge, Gy. Hungarian Academy of Sciences, Budapest (Hungary). Central Research Inst. for Physics. May 1989. 15p. Order Number DE89635984/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Results of calculations of prompt neutron emission characteristics are presented for the spontaneous fission of ^{252}Cf. The average number ν(A) and the average center of mass kinetic energy eta(A) of the neutrons as well as the total neutron spectra are calculated in terms of the fragment mass. The available excitation energies of the fragment pairs are the input data, divided between the fragments by a thermal equilibrium assumption taking into account the equilibrium statistical fluctuations too. The total angular and energy distributions in the laboratory frame are built up of those of the individual fragments. The evaporation calculations show that the high energy behaviour of the spectra is governed rather by the temperatures than by the details of the individual cascade spectrum forms. The experimental data are reproduced by the calculated ones fairly well, so there is no need for assuming existence of additional scission neutrons. (author) 24 refs.; 4 figs.

46561 (LA-UR–89-2505) **Green's Function Monte Carlo calculations of light nuclei.** Carlson, J. Los Alamos National Lab., NM (USA). [1989]. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8907127–2: 12. few body conference, 2-8 Jul 1989). Order Number DE89015295/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Recently, Green's Function Monte Carlo methods have been developed which enable one to perform exact calculations for the ground states of three and four body nuclei. These methods allow the alpha particle to be used as a testing ground for a variety of two- and three-nucleon interaction models, both in terms of their ground state energies and a variety of other ground state expectation values. We present a brief review of GFMC methods as applied to light nuclei, including recent improvements of the algorithm and a discussion of the prospects for the inclusion of momentum-dependent terms. We then discuss results for the ground state energy, one- and two-body density distributions, D-state probability, coulomb sum rule, and momentum distributions. The GFMC results are compared to experimental results and to variational Monte Carlo calculations. 27 refs., 5 figs., 1 tab.

46562 (LA-UR–89-2790) **Calculated alpha-induced thick-target neutron and radionuclide yields for $E_{\alpha} \leq$ 50 MeV.** Bozoian, M.; Perry, R.T.; Wilson, W.B. Los Alamos National Lab., NM (USA). 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8906186–4: Materials Research Society materials analysis workshop, 14-17 Jun 1989). Order Number DE89016977/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Thick-target yields for αs incident on elements $4 \leq Z \leq 15$ and $Z = 17$ have been calculated using the α stopping data of Ziegler with radionuclide production cross sections calculated with the GNASH code. Comparisons are made of the calculated cross sections with sparse measured data. Radionuclide production yields are tabulated at 5, 10, 20, 30, 40 and 50 MeV. 9 refs., 3 figs., 13 tabs.

46563 (LBL–27454) **BRANDEX: A FORTRAN/Pascal code to calculate the multiple binary splitting of an excited nucleus.** Knop, R.; Stokstad, R.G. Lawrence Berkeley Lab., CA (USA). May 1989. 20p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. Order Number DE89016338/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

BRANDEX is a statistical calculation based on averages of physical distributions that will predict cross sections for particle coincidence channels resulting from the breakup of an excited nucleus through a sequential binary process. With minor modification, it can make predictions for an arbitrary nucleus, integrating over an arbitrary weighted range of excitation. An example is given for ^{16}O breakup using the experimentally obtained excitation energy distribution. 4 refs., 6 figs.

46564 (ORNL/TM–9179/R2) **Updated users' guide for SAMMY: Multilevel R-matrix fits to neutron data using Bayes' equation: Revision 2.** Larson, N.M. Oak Ridge National Lab., TN (USA). Jun 1989. 161p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89015659/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

In 1980 the multilevel multichannel R-matrix code SAMMY was released for use in analysis of neutron data at the Oak Ridge Electron Linear Accelerator. Since that time, SAMMY has undergone significant modifications: user-friendly options have been incorporated to streamline common operations and to protect a run from common user errors; the Reich-Moore formalism has been extended to include an optional logarithmic parameterization of the external R-matrix, for which any or all parameters may be varied; the ability to vary sample thickness, effective temperature, matching radius, and/or resolution-broadening parameters has been incorporated; to avoid loss of information (i.e., computer round-off errors) between runs, the "covariance file" now includes precise values for all variables; and unused but correlated variables may be included in the analysis. Because of these and earlier changes, the 1980 SAMMY manual is now hopelessly obsolete. This report is intended to be complete documentation for the current version of SAMMY. Its publication in looseleaf form will permit updates to the manual to be made concurrently with updates to the code itself, thus eliminating most of the time lag between update and documentation. 28 refs., 54 tabs.

46565 (ORNL/TM–11297) **URR [Unresolved Resonance Region] computer code: A code to calculate resonance neutron cross-section probability tables, Bondarenko self-shielding factors, and self-indication ratios for fissile and fertile nuclides.** Leal, L.C.; de Saussure, G.; Perez, R.B. Oak Ridge National Lab., TN (USA). 15 Aug 1989. 30p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89016941/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The URR computer code has been developed to calculate cross-section probability tables, Bondarenko self-shielding factors, and self- indication ratios for fertile and fissile isotopes in the unresolved resonance region. Monte Carlo methods are utilized to select appropriate resonance parameters and to compute the cross sections at the desired reference energy. The neutron cross sections are calculated by the single-level Breit-Wigner formalism with s-, p-, and d-wave contributions. The cross-section probability tables are constructed by sampling the Doppler broadened cross-section. The various shelf-shielded factors are computed numerically as Lebesgue integrals over the cross-section probability tables. 6 refs.

46566 (UCRL–101175) **Experimental and theoretical studies of odd-odd deformed nuclei.** Hoff, R.W. Lawrence Livermore National Lab., CA (USA). 13 Jun 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8906168–3: International conference on selected topics in nuclear structure, 20-24 Jun 1989). Order Number DE89016512/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The application of a simple semi-empirical model is discussed in terms of interpreting experimental nuclear structure data for twelve of the best characterized odd-odd deformed nuclei. An essential part of this modeling is to calculate values for the Gallagher-Moszkowski splitting and Newby shifts, the observables that arise from the n-p residual interaction in odd-odd nuclei. Assumptions regarding the form for this n-p force are traced historically, beginning with a delta force and including finite-range central forces of various descriptions, the necessary introduction of a tensor force to allow proper calculation of certain Newby shifts, and the use of the Skyrme III interaction to determine the ingredients of a Bohr-Mottelson unified-model description through the Hartree-Fock-Bogolyubov approximation. The predictive power of a favored form of the n-p force, one that produced a remarkably good fit to E(G-M) data in 1976, is examined in light of experimental data obtained since its formulation. A data set of 42 experimentally determined Newby shifts has been reviewed as to the reliability of each entry. Exceptions to a recently proposed rule for the a priori determination of the sign of a Newby shift are discussed. Evidence is presented for the existence of odd-even staggering in the rotational spacings of many K^- bands (with $K>0$). By use of Coriolis-coupling calculations, it has been possible to reproduce the odd-even staggering observed in some of the K^- rotational bands of 168Tm, 176Lu, 182Ta, and 182Re. 26 refs., 2 figs., 3 tabs.

46567 The role of compound nuclei in intermediate energy heavy ion reactions. Moretto, L. (Lawrence Berkeley Lab., CA (USA)). pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

Hot compound nuclei are frequently produced in intermediate energy reactions through a variety of processes. At high excitation energies compound nuclei can decay by modes that are very improbable at lower energies. Thus complex fragments, high energy gamma rays and even pions can be emitted with sizeable probability. These emission are interesting on their own right, as they reflect the properties of nuclei near the limit of thermal instability, but they must also be considered as a potentially strong background to less conventional processes. In the case of gamma ray emission it will be shown that in a specific reaction all the gamma ray are attributable to compound emission rather than to nucleon-nucleon bremsstrahlung. Furthermore complex fragments unrelated to target and projectile are arising from compound binary decay up to 100 MevA rather than from liquid vapor equilibrium. Finally apparently high temperatures in pion spectra may be due to energy fluctuations between compound nuclei present in the exit channel.

46568 Decomposition of the total reaction cross section at energies around the coulomb barrier. Wolfs, F.L.H. (Argonne National Lab., IL (USA)). pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). DOE

Contract W-31-109-ENG-38. (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

The fusion yields observed in heavy-ion reactions around the Coulomb barrier are in general much larger than the yields calculated using simple barrier penetration models. This sub-barrier fusion enhancement has been interpreted in terms of a coupling between the elastic channel and other reaction channels which effectively lowers the fusion barrier. At Argonne we have studied the decomposition of the total reaction cross section at energies around the Coulomb barrier in great detail in order to establish the relative strength of the contributing reaction channels. These studies showed not only that the quasielastic scattering yields are the dominating contribution to the total reaction cross section, but also a considerable enhancement of deep-inelastic scattering compared to simple classical model estimates. Experiment and their relation to sub-barrier fusion are discussed.

46569 Heavy-ion reactions near and below the coulomb barrier. Esbensen, H. (Argonne National Lab., IL (USA)). pp. 16 of 196th ACS national meeting. American Chemical Society, Washington, DC (US) (1988). DOE Contract W-31-109-ENG-38. (CONF-8809241–: Symposium on the interface between nuclear structure and reactions, 25-30 Sep 1988).

The experimental knowledge of heavy-ion reactions near the Coulomb barrier has been improved considerably in the past decade. Cross sections and angular distributions for the most dominant reaction channels have been measured for several systems and one has observed large enhancements of subbarrier fusion cross sections compared to one-dimensional barrier penetration models. It has been an important issue to try to understand the interplay between the different reaction channels and, in particular, their influence on fusion and elastic scattering. The present understanding of this interplay is reviewed, and coupled-channels calculations that attempt to give a realistic description of the most dominant reaction channels are discussed.

46570 Coupled-channels calculations of elastic and inelastic scattering. Esbensen, H. (Physics Division, Argonne National Laboratory, Argonne, Illinois 60439(US)); Videbaek, F. *Physical Review [Section] C: Nuclear Physics (USA)*, 40(1): 126-131 (Jul 1989). DOE Contract W-31-109-ENG-38.

Cross sections for the elastic and inelastic scattering of ^{16}O on ^{58}Ni, ^{88}Sr, ^{40}Ca, and ^{48}Ca have been calculated in a coupled-channels treatment, including the low-lying 2^+ and 3^- states of both projectile and target. Real, energy-independent ion-ion potentials and form factors were used, and fusion was simulated by ingoing wave boundary conditions in all channels. The agreement with the measured scattering data is qualitatively as good as obtained in previous optical-model calculations.

6540 Radiation and Shielding Physics

Refer also to citation(s) 46007, 46565

46571 (INIS-BR–1574) **Solution of Milne problem by Laplace transformation with numerical inversion.** Campos Velho, H.F. de. Rio Grande do Sul Univ., Porto Alegre, RS (Brazil). Dec 1987. 46p. (In Portuguese). Order Number DE89635964/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The Milne problem for monoenergetic neutrons, by Laplace Transform of the neutron transport integral equation with numerical inversion of the transformed solution by gaussian quadrature, using the fatorization of the dispersion function. The resulted is solved compared its analitical solution. (author).

6550 Medical Physics

Refer also to citation(s) 45084, 45116, 46310

46572 (EUR–11608, pp. 127-144) **Principles of dose limitation in radiation protection.** Kaul, A. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8710489–: 1. meeting of the standing conference on health and safety in the nuclear age, 5-7 Oct 1987). In *Health and safety in the nuclear age*. Order Number DE89908200/JAW. Available from NTIS (US Sales Only), PC A12/MF A01.

The aim of radiation protection is to protect individuals, their offspring and the population as a whole against harmful effects from ionizing radiation and radioactive substances. Harmful effects may be either somatic, i.e. occurring in the exposed person himself/herself, or hereditary, i.e. occurring in the exposed person's offspring. Successful radiation protection involves (a) protective measures based on the results of research into the biological and biophysical effects of radiation and (b) ensuring that activities necessitating exposure are justified and that the degree of exposure is minimal. This benefit/risk principle ceases to apply if a radiation source is out of control, since the main aim is then to introduce risk limitation measures, provided that these are of positive net benefit to the individual and the population as a whole. This paper discusses the principles of dose limitation as a function of exposure conditions, i.e. controlled or uncontrolled exposure to a source of radiation.

6560 Condensed Matter Physics

Refer also to citation(s) 45455, 45456, 45507, 45508, 45509, 45510, 45511, 45544, 45702, 45812, 46272, 46387, 46410, 46727, 46728, 46729

46573 (CONF-890426–27) **Diffusion, segregation, and recrystallization in high-dose ion-implanted Si.** Pennycook, S.J. Oak Ridge National Lab., TN (USA). Jul 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Spring meeting of the Materials Research Society; 24-28 Apr 1989. Order Number DE89016224/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Using the new technique of Z-contrast scanning transmission electron microscopy (STEM), we have been able to study the segregation of Sb at an advancing SPE growth interface and the resulting interface breakdown. The first direct information is obtained on Sb diffusion in the amorphous phase, which is many orders of magnitude enhanced over tracer crystalline values. This controls both the dopant incorporation and the stability of the resulting supersaturated alloy. These results are compared to the behavior of the low melting point substitutional diffusers and the interstitial diffusers. 23 refs., 8 figs.

46574 (CONF-890708–6) **Collisionally induced stochastic dynamics of fast ions in solids.** Burgdoerfer, J. Oak Ridge National Lab., TN (USA). [1989]. 11p. Sponsored by DOE/ER;NSF. DOE Contract AC05-84OR21400. From 16. international conference on the physics of electronic and atomic collisions; 26 Jul - 1 aug 1989. Order Number DE89015983/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Recent developments in the theory of excited state formation in collisions of fast highly charged ions with solids are reviewed. We discuss a classical transport theory employing Monte-Carlo sampling of solutions of a microscopic Langevin equation. Dynamical screening by the dielectric medium as well as multiple collisions are incorporated through the drift and stochastic forces in the Langevin equation. The close relationship between the extrinsically stochastic dynamics described by the Langevin and the intrinsic stochasticity in chaotic nonlinear dynamical systems is stressed. Comparison with experimental data and possible modification by quantum corrections are discussed. 49 refs., 11 figs.

46575 (CONF-890821–2) **Dielectronic excitation and recombination in crystal channels.** Datz, S.; Vane, C.R.; Dittner, P.F.; Giese, J.P.; Gomez del Campo, J.; Jones, N.L.; Krause, H.F.; Miller, P.D.; Schulz, M.; Schone, H.; Rosseel, T.M. Oak Ridge National Lab., TN (USA). 1989. 24p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. international conference on atomic collisions in solids; 7-11 Aug 1989. Order Number DE89016864/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Dielectronic excitation and recombination have been observed during the interaction of channeled ions (H-like S, Ca, and Ti and He-like Ti) with the electrons contained in ⟨110⟩ and ⟨100⟩ channels in Si. As in dielectronic recombination, the products of the reaction are an ion of reduced charge state and the emission of a photon(s). However, the high electron density in the channel introduces

collisional mechanisms for the destruction of the doubly excited intermediate state and even the formation of ions with increased charge state. The experiments prove that crystal channels may be treated quantitatively as a dense electron target for ions with velocity $v_i >> v_f$, the Fermi velocity of the electrons in the channel. 14 refs., 8 figs., 1 tab.

46576 Coherent excitations of nuclei in crystals by synchrotron radiation pulses. Trammell, G.T. (Rice Univ., Houston, TX (USA)); Hannon, J.P. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Synchrotron pulses will excite low lying nuclear levels, and in crystals, will create nuclear exciton states which are spatially coherent superpositions of the various excited state hyperfine levels of all the nuclei in the crystal. The subsequent radiative decay is radically affected by coherence, exhibiting both a speed-up due to coherent enhancement, and a quantum beat modulation of the decay rate which gives a periodic speed-up/slow-down of the rate for photon decay into the coherent channels. For a nuclear exciton in an antiferromagnet, the quantum beat modulation will result in an interesting temporal pendulosung effect. 22 refs.

46577 Nuclear Bragg diffraction using synchrotron radiation. Ruffer, R. (Universitaet Hamburg (Germany, F.R.)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Nuclear Bragg diffraction in combination with synchrotron radiation will become a powerful new x-ray source in the Å-region. This new source exceeds already Mossbauer sources in brilliance giving Mossbauer scattering experiments further impetus. With the planned dedicated storage rings synchrotron radiation, filtered by measures of the Mossbauer effect, will not only allow new types of Mossbauer experiments but offers also a new x-ray source for μeV resolution and long coherence length x-ray optics. The first experiments had shown that there is a resonance in the diffraction spectra and even that the diffracted x-rays are highly monochromatic. Although these experiments had shown the expected time behavior, an improved fast detector revealed the complete time spectra in all details. These experiments point out the basic phenomena connected with the nuclear Bragg diffraction of γ-quanta: speedup (coherent enhancement), quantum beats, and polarization mixing (Faraday rotation, etc.,). The speedup in the time spectra- a dynamical effect of the diffraction, depends on the angle of incidence and is most pronounced at the beginning of the time spectra. This is clearly and very easily seen in the measurements of the antiferromagnetic $^{57}FeBO_3$. In the quantum beats the hyperfine splitting of the nuclear levels and/or the resonance shifts between different nuclear sites in the crystal are expressed. The observation of quantum beats allows a sensitive and direct determination of the hyperfine interaction parameters. 2 refs.

46578 The production of long coherence-length hard x-rays using nuclear Bragg scattering of synchrotron radiation. Siddons, D.P. (Brookhaven National Lab., Upton, NY (USA)). pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Recently, several experimenters have successfully observed nuclear Bragg scattering from crystals containing ^{57}Fe. By coherently exciting the 14.4keV resonance at the Bragg condition, almost pure beams of extremely monochromatic radiation can be generated. Although the intensities observed are so far quite low, the brightness produced by these techniques exceeds that available from radioactive sources. Instrumental improvements will soon make possible interesting new experiments. Several properties of the nuclear Bragg reflection process are interesting in themselves. These include the observation of beating in the time domain among hyperfine split resonance lines, and polarization mixing produced by scattering from oriented circularly polarized oscillators. Some speculations on the potential applications of this new source of long coherence-length radiation will be presented.

46579 Studies of hot, solid materials produced by an ultrashort pulse laser. Milchberg, H.M. (Univ. of Maryland, College Park (USA)); Freeman, R.R. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

A series of ultrashort pulse laser-solid interaction experiments have been performed using copper and aluminum which illustrate charge transport properties of these strongly heated materials at near-solid density. In aluminum, as a drude metal at the laser wavelength, the transport is seen to be strongly dominated by collisions with the appearance of a minimum mean free path. In copper, band absorption of the laser light is seen to be a strong process even at $\sim$ 50 eV temperatures. In the context of using ultra-short pulse laser-produced plasmas as a source of ultra-short pulse soft x-rays, evidence is presented that heat loss mechanisms in these hot solids may not be sufficiently rapid to result in subpicosecond soft x-ray bursts. 5 refs., 4 figs.

46580 (CONF-8906155–5) **Annealing environment effects in solid-phase epitaxial regrowth of Fe-implanted Al_2O_3.** McCallum, J.C.; White, C.W.; Sklad, P.S.; McHargue, C.J. Oak Ridge National Lab., TN (USA). Jun 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Radiation effects in insulators-5: crystalline oxides and ceramics session; 19-23 Jun 1989. Order Number DE89016843/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Samples of c-axis Al_2O_3 were implanted with Fe(160 keV,4 x $10^{16}/cm^2$) at liquid nitrogen temperature and then thermally annealed at temperatures of 900,960 and 1100°C in an oxidising environment (flowing O_2) or in a reducing environment (flowing 96% Ar, 4% H). Rutherford backscattering spectrometry, ion channeling, and transmission electron microscopy of the crystals revealed differences in the annealing characteristics of the implanted layers that depended on the annealing environment. These results indicate the importance of the annealing atmosphere in determining the characteristics of epitaxially regrown layers in ion-implanted and thermally annealed Al_2O_3. 15 refs., 5 figs.

46581 (CONF-8906197–1) **Effects on ion implantation on intermediate range order: IR spectra of silica.** Magruder, R.H. III; Morgan, S.H.; Weeks, R.A.; Zuhr, R.A. Oak Ridge National Lab., TN (USA). 1989. 22p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 10. university conference on glass science; 7-9 Jun 1989. Order Number DE89016081/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The reflectance spectra of ion unimplanted SiO_2 glass has been measured from 5000cm^{-1} to 400cm^{-1}. The silica was implanted with Ti, Cr, Mn, Fe, Cu and Bi to nominal doses ranging from 1 x 10^{15} ions/cm^2 to 1.2 x 10^{17} ions/cm^2 at an energy of 160 KeV and currents of approximately 2.6 μA/cm^2. Changes in the intensity of the 1232cm^{-1} and 1015cm^{-1} vibrational modes are attributed to changes in the intermediate range order and to changes in the concentration of non-bridging oxygen (NBO) defects in the implanted layer. These changes are ion and dose dependent. The differing effects on IRO and NBO are attributed to the chemical interaction of the implanted ions with the substrate. 23 refs., 5 figs., 2 tabs.

46582 (DOE/ER/10742–3) **Development of an x-ray beam line at the NSLS [National Sychrotron Light Source] for studies in materials science using x-ray absorption spectroscopy: Progress report.** Sayers, D.E. North Carolina State Univ., Raleigh, NC (USA). Dept. of Physics. 1988. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AS05-80ER10742. Order Number DE89016896/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

This paper briefly discusses progress on the beam lines at the National Synchrotron Light Source. Experiments on amorphous materials are also discussed. (LSP)

46583 (DOE/ER/45233–4) **Studies of ultrathin magnetic films and particle-surface interactions with spin-sensitive electron spectroscopies: Progress report, 1 January 1989–30 November 1989.** Walters, G.K.; Dunning, F.B. Rice Univ., Houston, TX (USA). Aug 1989. 9p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER45233. Order Number DE89016741/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Research during the fourth year of this grant has focused on: investigation of spin-exchange in electron scattering from nonmagnetic metallic surfaces by means of Spin-Polarized Electron Energy Loss Spectroscopy (SPEELS); and studies of magnetic properties of the Fe(110) surface, and the effect of an oxygen overlayer, utilizing Spin-Polarized Metastable Atom De-excitation Spectroscopy (SPMDS). 7 refs., 2 figs.

46584 (DOE/ER/45370–1) **Morphological analysis of ionomers: Progress report, August 1, 1988–March 31, 1989.** Wisconsin Univ., Madison, WI (USA). [1989]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-88ER45370. Order Number DE89016023/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This report discusses; small-angle x-ray scattering (ASAXS) from amorphous ionomers; ASAXS from semicrystalline ionomers; and polymer synthesis for proposed research. (LSP)

46585 (IC–88/412) **New type of surface acoustic waves in solids due to nonlinear elasticity.** Mozhaev, V.G. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 8p. Order Number DE89635748/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

It is shown that in nonlinear elastic semi-infinite medium possessing a property of self focusing of shear waves, besides bulk non-linear shear waves, new surface acoustic waves exist, localization of which near the boundary is entirely due to nonlinear effects. (author). 8 refs.

46586 (IC–89/24) **Dipolar fluid-wall systems. Beyond the image potential.** Boudh-hir, M.E. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 15p. Order Number DE89635749/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The case of dipolar fluid in front of an ideal wall is examined. The surface-fluid system is introduced as a limit case of a binary mixture Using the diagrammatic development, the expansion of the one-particle distribution function is given. 16 refs.

46587 (IC–89/25) **Pair distribution function in polar fluid-hard wall systems. Long range components.** Boudh-hir, M.E. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 16p. Order Number DE89635750/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Using the diagrammatic technique we prove that the total correlation function for dipolar fluid systems in front of an ideal wall has four long range components. 21 refs.

46588 (IC–89/26) **New developments for localized adsorption.** Boudh-hir, M.E. International Centre for Theoretical Physics, Trieste (Italy). Feb 1989. 20p. Order Number DE89635751/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Using the diagrammatic expansion, new developments for localized adsorption are found. It is proved that the correlations in the system, in the absence of the attractive site potential, and the periodicity of the sites play a fundamental role in the adsorption phenomena. 14 refs, 2 figs, 2 tabs.

46589 (IC–89/29) **Anomalies of the longitudinal magnetothermoelectric power of metal in the vicinity of electronic topological transition.** Blanter, Ya.M.; Pantsulaya, A.V.; Varlamov, A.A. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 37p. Order Number DE89635763/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The longitudinal magnetothermoelectric power (MTEP) is calculated for metal in magnetic field and in the vicinity of electronic topological transition (ETT). The giant oscillations of MTEP as the function of applied magnetic field are found. These oscillations originate from the energy dependence of electron relaxation time in magnetic field and they are peculiar to any normal metal independently on the shape of its Fermi surface. Nevertheless the ETT essentially changes the form and magnitude of such oscillations. The results of recent experimental investigation of MTEP in cadmium monocrystals under the pressure and in magnetic field are discussed from the point of view of the theory presented. (author). 23 refs, 6 figs.

46590 (IC–89/37) **Freezing of Coulomb liquids.** Tosi, M.P. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 17p. Order Number DE89635752/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Recent progress in the theory of liquid-solid coexistence as approached from the liquid phase in systems with Coulomb forces is reviewed. Main attention is given to (i) Wigner crystallization of the electron gas in the degenerate and classical limits, and (ii) localization of bond particles leading to freezing in a pseudoclassical liquid-state version of the bond-charge model for elemental semiconductors. These models serve to illustrate crystallization driven by pure Coulomb repulsions and crystallization resulting from the interplay of attraction and repulsions in multicomponent systems, respectively. (author). 29 refs, 4 figs.

46591 (IC–89/75) **Thermodynamic studies on the ferroelectric phase transition in neutron irradiated $(Li_xK_{1-x})_2SO_4$ crystals at high temperature.** Kassem, M.E.; El-Khatib, A.M.; Ammar, E.A.; Denton, M.M. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 14p. Order Number DE89635786/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Thermodynamic studies of $(Li_xK_{1-x})_2SO_4$, LKS, mixed crystals have been made in the concentration range (x=0.1,0.2,...,x=0.5). The thermal behavior has been investigated by differential thermal analysis, DTA, and differential scanning calorimeter, DSC, in the vicinity of high temperature phases. Also, the effect of the mixed neutron field of fast and thermal neutrons (10% of the reactor neutron pile is fast neutrons) on the thermal properties of mixed crystals was studied. The results showed a change in the transition temperature Tc, as well as the value of specific heat C_t at transition temperature, due to the change of stoichiometric ratio and radiation doses. The change of enthalpy and entropy of mixed crystals have been estimated numerically. The obtained small values of $\Delta S/R$ is characteristic of incommensurate phase transition as previously confirmed by the results of neutron diffraction technique. (author). 16 refs, 5 figs, 1 tab.

46592 (IC–89/76) **Fractal dimension of the fractured surface of materials.** Lung, C.W.; Zhang, S.Z. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 11p. Order Number DE89635764/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Fractal dimension of the fractured surface of materials is discussed to show that the origin of the negative correlation between D_F and toughness lies in the method of fractal dimension measurement with perimeter-area relation and also in the physical mechanism of crack propagation. (author). 8 refs, 4 figs, 1 tab.

46593 (INIS-BR–1558) **Renormalization techniques applied to the study of density of states in disordered systems.** Ramirez Ibanez, J. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. 1985. 132p. (In Portuguese). Order Number DE89635765/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

A general scheme for real space renormalization of formal scattering theory is presented and applied to the calculation of density of states (DOS) in some finite width systems. This technique is extended in a self-consistent way, to the treatment of disordered and partially ordered chains. Numerical results of moments and DOS are presented in comparison with previous calculations. In addition, a self-consistent theory for the magnetic order problem in a Hubbard chain is derived and a parametric transition is observed. Properties of localization of the electronic states in disordered chains are studied through various decimation averaging techniques and using numerical simulations. (author).

46594 (INIS-BR–1560) **Vibrational properties of amorphous semiconductors.** Schulz, P.A.B. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. 1985. 67p. (In Portuguese). Order Number DE89635766/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

A model for the lattice dynamics of a-Si_{1-X} N_X is introduced. This model is based on a Born hamiltonian, solved in the Bethe lattice approximation. Starting from the local density of vibrational states, we analize the infrared absoption spectra of this material. (author).

46595 (INIS-BR–1567) **Pairs of chalcogen impurities in silicon.** Paula Junior, H.F. de. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1988. 109p. (In Portuguese). Order Number DE89635767/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

The electronic structure of complex defects in silicon involving oxygen and sulfur (O-O, S-O and S-S), occupying different positions in the host crystal is studied. It is shown that the many-electron effects (via configuration interaction) are important to describe the correct ground state. The orbital base set is obtained through the LCAO-MO-INDO/S method. (author).

46596 (INIS-BR–1583) **Carbon-13 nuclear magnetic resonance of heterocyclic salts and its precursors.** Freire, H.R. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1989. 92p. (In Portuguese). Order Number DE89635768/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

The synthesis of 1,2,3,6 - tetrahydro - 1, 1 dimethyl - 3 - oxo - 5 phenylpyridinium bromides containing the substituents: H, Me, Cl, Br, OMe and NO_2 is described. The phenacyl bromides (8a-f) were characterized by their melting points and by their I.r. and ^1H n.m.r. spectra. Some studies on ^{13}C n.m.r. spectra of the phenacyl bromides (8a-f), the quartenary ammonium salts (7a-f) and the cyclic salts(6a-f) are shown. The effect of substituents on the eletronic structure of these compounds and on the chemical shifts of the different carbon atoms in terms of electronic and steric effects are discussed. (M.J.C.).

46597 (INIS-BR–1587) **Study of $Tl^0(1)$ and $In^0(1)$ defects in alkaline halides: prototype of a color center as active laser medium.** Vieira Junior, N.D. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 165p. (In Portuguese). Order Number DE89635769/JAW. Available from NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS.

The optical properties of the $Tl^0(1)$ and $In^0(1)$ centers in Kcl crystals in cation sites of the crystal lattice, perturbed by an adjacent anion vacancy. Emphasis is given to the lowest energy levels. Using a tagging optical absorption technique, the absorption bands were identified. The laser action of $Tl^0(1)$ center in KCl by pumping with Nd: YAG laser in the lowest energy absorption band was obtained. A simple way to achieve continuous single frequency laser operation using a grating as the sole tuning element is described. It is shown that, by proper choice of cavity parameters, the competing hole burning modes can be completely supressed. Experiments were carried out using $Tl^0(1)$ centers in KCl as the gain medium. The production of pulses via synchronous pumping of $Tl^0(1)$ color center in KCl are reported. (author).

46598 (INIS-BR–1588) **Magnetism of classical and quantum systems of localized spins.** Mariz, A.M. Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro, RJ (Brazil). 1985. 129p. (In Portuguese). Order Number DE89635770/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The static critical properties of localized are studied spin systems. Several models are discussed: (a) the anisotropic quantum Heisenberg ferromagnet on square lattice (with quenched bond-dilution and random anisotropy) and on simple cubic lattice; (b) the Z(4) ferromagnetic model on square lattice; (c) the Ising model on the Cayley tree, in the presence of competing interactions. The (a) and (b) problems are studied within a real-space Renormalisation Group (RG) approach. In both cases, methods to perform the relevant partial tracings, that are better than those available in the literature are developed. The critical frontiers obtained reproduce all known exact results, and they are high precision ones everywhere. Correlation lenght critical exponents (4u) and the crossover exponents (PHI) are also calculated. The values are, in degree of approximation, equal or superior to those obtained using the Migdal-Kadanoff RG. The (c) problem is investigated by constructing recursive relations (similar to RG); the resulting phase diagram (numerically exact) presents a set of modulated phases, besides the ferromagnetic, antiferromagnetic and paramagnetic ones. It is worth to stress the presence of metastability phenomena and the existence of the paramagnetic phase at arbitrary non-vanishing small temperatures. In addition to the previous works a study of the energy eigenvalues and the specific heat of a general anharmonic single quantum oscillator, by using the Turschner and WKB approximations was performed. Comparisons between them, exhibit the superiority of the Turschner approximation. (author).

46599 (INIS-BR–1591) **Preparation and spectrometric identification of amide derivatives with antimalaric.** Ferreira, E.J. Sao Paulo Univ., SP (Brazil). Inst. de Quimica. 1987. 423p. (In Portuguese). Order Number DE89635771/JAW. Available from NTIS (US Sales Only), PC A18/MF A01 - OSTI; INIS.

The structures of polymeric compounds using spectrometric analysis of infrared, ultraviolet and protonic magnetic resonance and ^{13}C nuclear magnetic resonance are studied. Some structural models are used such as antimalaric-sulfones and pyrimidinic derivatives, and non-polymeric derivatives of active compounds. A comparative analysis on structures less complexes is shown. (M.J.C.). Spectrums 186 p.

46600 (INIS-BR–1596) **Chalcogen donnors in silicon.** Scolfaro, L.M.R. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1985. 138p. (In Portuguese). Order Number DE89635772/JAW. Available from NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS.

The electronic stucture of chalcogen impurities in silicon which give rise to deep levels in the forbidden band gap of that semiconductor is studied. The molecular cluster model within the formalism of the multiple scattering method in the $X\alpha$ local density approximation was used . The surface orbitals were treated by using the Watson sphere model. Studies were carried out for the isolated substitutional sulfur and selenium impurities (Si:S and Si:Se). A pioneer investigation was performed for the nearest-neighbor impurity pairs of sulfur and selenium (Si:S_2 and Si:Se_2). All the systems were also analysed in the positive charge states (Si:S^+, Si:Se^+ and Si:Se_2^+) and for the isolated impurities the calculations were carried out to the spin polarized limit. The obtained results were used to interpret recent photoconductivity, photocapitance, EPR and DLTS data on these centers. It was observed that the adopted model is able to provide a satisfactory description of the electronic structure of the chalcogen impurity centers in silicon. (autor).

46601 (INIS-BR–1598) **Kinetic analysis of interstitial atomic hydrogen in a-Si:(H,O,N) and beryllia.** Furtado, W.W. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1986. 84p. (In Portuguese). Order Number DE89635787/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

A method for interpreting thermal decay of interstitial atomic hydrogen H^o_i produced by irradiation in a-Si: (H,O,N) and in beryllia was developed. The hypothesis of H^o_i were produced from RH type molecules by irradiation effect and trapped in the interstitials of studied elements was considered. The hypothesis of the heating causes the disarming of H^o_i, and can be retrapped, recombine with R matrices or react between themselves to form the H_2 molecules. The kinetic equations were arranged by a schematic method for each proposed reaction. These equations were solved numerically by RungeKutta method. The adjust parameters show that the H^o_i + H^o_i -> H_2 occurs only for beryllia, because the kinetic occurs at higher temperatures. All the parameters were adjusted to Arrhenius law, allowing to determine the activation energies for each process. (M.C.K.).

46602 (INIS-SU–92) **Physics and technique of millimeter and submillimeter waves.** AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Inst. Radiofiziki i Ehlektroniki. 1987. 49p. (In Russian). Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Individual papers are processed separately for the data base.

46603 (INIS-SU–92, pp. 3-7) **Resonance interaction of surface magnetoplasma polaritons in semiconductor layer.** Glukhov, O.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Inst.

Radiofiziki i Ehlektroniki. 1987. (In Russian). In *Physics and technique of millimeter and submillimeter waves.* Order Number DE89012210/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Magnetoplasma polaritons in semiconductor layer with asymmetric dielectric surroundings are studied. Resonance interaction of surface magnetoplasma polaritons propagating on the opposite boundaries of the semiconductor layer is investigated. Quantitative criteria for the effect existence are determined.

46604 (INIS-SU–92, pp. 30-31) **Excitation of electromagnetic oscillations by charged particle flux in semiconductor plate.** Yakovenko, I.V. AN Ukrainskoj SSR, Kharkov (Ukrainian SSR). Inst. Radiofiziki i Ehlektroniki. 1987. (In Russian). In *Physics and technique in millimeter and submillimeter waves.* Order Number DE89012210/JAW. Available from NTIS (US Sales Only), PC A03/MF A01; INIS.

Transition radiation of electron flux passing through the structure metal-semiconductor-metal is investigated. Matrix elements describing the processes of production and destruction of transverse electrons and photons during their interaction with electrons are found. The corresponding kinetic equations are obtained. The possibility of semiconductor eigen vibration instability as a result of induced radiation of nonequilibrium electrons is discussed.

46605 (INIS-SU–94/A, pp. 7-10) **Light Raman spectra of silicon subsurface layers implanted by selenium.** Avakyants, L.P.; Gorelik, V.S.; Obraztsova, E.D.; Khashimov, R.N. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012156/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie soobshcheniya po fizike.; no. 8.

Light Raman scattering (RS) in silicon crystal subsurface region is investigated; silicon is implanted by selenium ions with 100 keV energy and $1x10^{13}$, $3x10^{13}$, $3x10^{14}$, $1x10^{15}$ cm^{-2} doses. Frequency shifts and phonon line broadening during silicon ion implantation by selenium are detected on the basis of methods of difference RS spectroscopy near the surface. Quantitative characteristics of change in RS intensity depending on the selenium dose implanted to silicon are constructed. The results obtained permit to estimate mechanical stresses in semiconductor near-the-surface lyers subjected to ionic implantation to an accuracy of 10^8 H/m^2. 9 refs.; 3 figs.

46606 (INIS-SU–107/A, pp. 9) **ODMR in 2 ero field-new approch to coordination compound photoexcited states.** Kamyshnyj, A.L. (Moskovskij Gosudarstvennyj Univ., Moscow (USSR)); Sujsalu, A.P.; Aslanov, L.A. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.

Short Communication

46607 (INIS-SU–107/A, pp. 71) **Use of NMR-NQR on integer spins for nitrogen- and boron containing compound investigation.** Beloglazov, G.S. (Kaliningradskij Gosudarstvennyj Univ., Kaliningrad (USSR)); Beloglazov, S.M. AN SSSR, Moscow (USSR); Ministerstvo Vysshego i Srednego Spetsial'nogo Obrazovaniya RSFSR, Moscow (USSR); AN SSSR, Moscow (USSR). Nauchnyj Sovet po Neorganicheskoj Khimii; AN SSSR, Moscow (USSR). Inst. Obshchej i Neorganicheskoj Khimii; Kubanskij Gosudarstvennyj Univ., Krasnodar (USSR). 1988. (In Russian). (CONF-8810413–: 5. All-Union conference on spectroscopy of coordination compounds, 5 Oct 1988). In *5. All-union conference on spectroscopy of coordination compounds. Summaries of reports.* Order Number DE89012208/JAW. Available from NTIS (US Sales Only), PC A15/MF A01; INIS.

Short Communication

46608 (INIS-SU–113/A, pp. 3-4) **Interpretation of isostructural phase transition in $Pb_{1-x}Sn_xTe$(In).** Vinogradov, V.S. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1989. (In Russian). (T–23539). In *Experimental and theoretical physics. Collection.* Order Number DE89633984/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Kratkie soobshcheniya po fizike.; v. 1.

A sharp decrease in the constant of $Pb_{0.78}Sn_{0.22}Te$(In) lattice in the range of 0.7-0.8 at. % In is explained by the lattice deformation when the impurity level in In is populated by electrons. The deformation potential is determined, being $E_1 \simeq 15$ eV. 10 refs.

46609 (MLM–3603) **Ion implantation of two titanium alloys.** Barton, B.D.; Wittberg, T.N. EG and G Mound Applied Technologies, Miamisburg, OH (USA). 28 Aug 1989. 27p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-88DP43495. Order Number DE89016958/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Samples of two titanium alloys, Ti-6Al-4V and Ti-15V-3Cr-3Sn-3Al, were ion implanted with a combination of nitrogen (N^+) and oxygen (O^+). For each alloy, implantation parameters were chosen to give implanted nitrogen concentrations of approximately 10 atom % in one case and 50 atom % in another, from a depth of 100 nm to a depth of 400 nm. In all but one case, dual energy (200 keV and 90 keV) implantations of nitrogen were used to give a relatively uniform nitrogen concentration over a region of 300 nm. In each case, oxygen was implanted at 35 keV, following the nitrogen implantation, to give an oxygen-enriched region near the surface. The implanted samples were examined by optical microscopy and by Auger electron spectroscopy (AES). Depth profiles, determined by AES combined with argon ion sputtering, were in good agreement with theoretical predictions. Experimental observations were consistent with the formation of a solid solution of nitrogen in a titanium alloy phase in the case of alloys implanted to a level of 10 atom %; and compound formation was indicated in the case of alloys implanted to a level of 50 atom %. 20 refs.

46610 Quantitative studies of glow-discharge deposition using optical emission spectroscopy. Kampas, F.J. (Div. of Metallurgy and Materials Science, Brookhaven National Lab., Upton, NY (US)). vp. of Plasma synthesis and etching of electronic materials. Chang, R.P.H.; Abeles, B. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, 26-29 Nov 1984).

Intensities of CH optical emission and electrical properties of methane rf discharges as a function of pressure are presented and discussed. The results are consistent with a model in which the properties of the discharge are dominated by secondary electrons traversing the gap between the electrodes.

46611 Ion-enhanced chemical reaction of XeF_2 with silicon by modulated molecular beam mass spectrometry. Balooch, M. (Chemistry and Materials Science Div. of Lawrence Livermore National Lab. (US)); Olander, D.R.; Siekhaus, W.J. vp. of Plasma synthesis and etching of electronic materials. Chang, R.P.H.; Abeles, B. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, 26-29 Nov 1984).

The reaction of XeF_2 with the Si(100) surface was studied by modulated (10-1000 Hz) molecular beam-mass spectrometry in the temperature range 300-1300K and equivalent XeF_2 pressure of $5x10^{-6}$ to 10^{-4} Torr. Simultaneous bombardment of the reacting surface by Ar^+ was used to determine the extent of ion-enhancement of the reaction. In the absence of the ion beam, the main reaction product was SiF_4, whiich was formed with a reacton probability of $-5x10^{-2}$ at room temperature. In the presence of the ion beam three products, SiF_4, SiF_2 and F_2 (or F), were detected with formation probabilities of $-1x10^{-1}$, $6x10^{-2}$ and $7x10^{-2}$ respectively. Increasing surface temperature reduced the ion-enhanced reactivity.

46612 Simulation of spatially dependent excitation rates and power deposition in RF discharges for plasma processing. Kushner, M.J. (Mathematical Science Northwest, 2755 Bellevue Way, Bellevue, WA (US)); Anderson, H.M.; Hargis, P.J. vp. of Plasma synthesis and etching of electronic materials. Chang,

R.P.H.; Abeles, B. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, 26-29 Nov 1984).

In low pressure, radio frequency (RF) discharges of the type used in plasma processing of semiconductor materials, the rate of electron impact excitation and energy transfer processes depends upon both the phase of the RF excitation and position in the discharge. Electron impact collisions create radicals that diffuse or drift to the surfaces of interest where they are adsorbed or otherwise react. To the extent that these radicals have a finite lifetime, their transport time from point of creation to surface of interest is an important parameter. The spatial dependence of the rate of the initial electron impact collisions is therefore also an important parameter. The power that sustains the discharge is coupled into the system by two mechanisms: a high energy e-beam component of the electron distribution resulting from electrons falling through or being accelerated by the sheaths, and by joule heating in the body of the plasma. In this paper, the authors discuss the spatial dependence of excitation rates and the method of power deposition iin RF discharges of the type used for plasma processing.

46613 Plasma deposition of wide gap, highly photoconductive a-Si:H thin films from disilane-helium mixtures. Rajeswaran, G. (Div. of Metallurgy and Materials Science, Brookhaven National Lab., Upton, NY (US)); Vanier, P.E.; Corderman, R.R.; Kampas, F.J. vp. of Plasma synthesis and etching of electronic materials. Chang, R.P.H.; Abeles, B. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, 26-29 Nov 1984).

Wide gap (>1.9 eV), photoconductive, intrinsic amorphous silicon films were made in a UHV system from Si_2H_6-He mixtures. The hydrogen concentrations, optical gaps and photoconductivities were measured. Unlike films made from SiH_4, Si_2H_6-produced films exhibit excellent electronic properties even at low deposition temperatures. The ratio of Am1 photoconductivity to dark conductivity was as high as 10^7.

46614 Plasma deposition of amorphous metal alloys. Hays, A.K. (Sandia National Labs., Div. 1831, Albuquerque, NM (US)). vp. of Plasma synthesis and etching of electronic materials. Chang, R.P.H.; Abeles, B. Materials Research Society, Pittsburgh, PA (1985). (CONF-841157–: Materials Research Society annual meeting, 26-29 Nov 1984).

Rapid solidification, sputtering and electroless chemical deposition have been used to produce amorphous metal alloys which possess excellent corrosion and abrasion resistance. This paper discusses a new technique for obtaining amorphous metal alloy coatings. Plasma decomposition of $Ni(CO)_4$ and PH_3 in argon and hydrogen carrier gases [$Ni(CO_4/PH_3$–8/1] yielded films that were black and silver, respectively, in appearance. Both films were amorphous as determined by transmission electron microscopy. Films deposited using a hydrogen carrier gas were three orders of magnitude more conductive than those deposited using an argon carrier gas. Analysis of both films using electron microprobe analysis and inductively-coupled plasma spectroscopy showed an enrichment of P in the films over the P content in the plasma gas mixtures. Reducing the P content of the plasma gas mixture [$Ni(CO)_4/PH_3$–17/11 yielded crystalline films with no P enrichment. The grain size in these films was –60Δ as determined by x-ray line-broadening.

46615 Near-surface compositional modifications of ternary alloys during sputtering at elevated temperatures. Yacout, A.M. (Argonne National Lab., IL (USA). Materials Science Div.); Lam, N.Q.; Stubbins, J.F. *Nuclear Instruments and Methods in Physics Research, Section B: Beam Interactions with Materials and Atoms (Netherlands),* 42(1): 49-60 (May 1989). DOE Contract W-31-109-ENG-38.

The complex interplay of several physical processes in producing changes in the surface and subsurface compositions of ternary alloys during high-temperature ion bombardment has been theoretically investigated, using a phenomenological model that includes Gibbsian adsorption, preferential sputtering, displacement mixing, radiation-enhanced diffusion, and radiation-induced segregation. Sample calculations were performed for an Fe-Cr-Ni solid solution, representative of an austenitic stainless steel, under 3 keV Ne^+ sputtering. The effects of the diverse phenomena involved were examined in details as a function of time and temperature. The present model calculations provide useful information about ion-beam modifications, which is important in the areas of sputter depth-profiling of multicomponent materials and elevated-temperature ion implantation. (orig.).

46616 MEASTRI: A hybrid analytical/Monte Carlo code for particle transport in solids. Brice, D.K. (Sandia National Labs., Albuquerque, NM (USA)). *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands),* 162-164: 164 (Apr 1989). DOE Contract AC04-76DP00789. (CONF-8805285–: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

We report on a hybrid analytic/Monte Carlo code for evaluating particle transport in solids. In this code, atomic concentrations in the near surface implanted region of a target material, $N_k(x, t)$, are propagated in time through the method of equivalent atomic stopping (MEAS). The implantation source profiles $P_k(x, t)$, initially obtained from the TRIM code, are propagated along with the $N_k(x, t)$. In addition, TRIM is invoked periodically to provide updated profiles $P_k(x, t)$, since the MEAS procedure includes only first order corrections to the P_k. The code provides for simultaneous implantation of different atomic species and includes the local mixing model (LMM) for describing buildup to saturation and isotope exchange for implantation of hydrogen and/or other species. Since the MEAS procedure is analytic, both sputtering and diffusion are included in a natural way, and disparate time scales, e.g. for implantation, sputtering and diffusion, are easily accommodated. The code is particularly useful for high fluence implantation. Example calculations for simultaneous C and D implantation into graphite are compared with experimental data obtained from TFTR limiter tiles. (orig.).

46617 Numerical study of the two-dimensional Hubbard model. White, S. R. (Department of Physics, University of California, Santa Barbara, Santa Barbara, California 93106(US)); Scalapino, D. J.; Sugar, R. L.; Loh, E. Y.; Gubernatis, J. E.; Scalettar, R. T. *Physical Review [Section] B: Condensed Matter (USA),* 40(1): 506-516 (1 Jul 1989). DOE Contract FG03-85ER45197.

We report on a numerical study of the two-dimensional Hubbard model anddescribe two new algorithms for the simulation of many-electron systems. Thesealgorithms allow one to carry out simulations within the grand canonicalensemble at significantly lower temperatures than had previously been obtainedand to calculate ground-state properties with fixed numbers of electrons. Wepresent results for the two-dimensional Hubbard model with half-andquarter-filled bands. Our results support the existence of long-rangeantiferromagnetic order in the ground state at half-filling and its absence atquarter-filling. Results for the magnetic susceptibility and the momentumoccupation along with an upper bound to the spin-wave spectrum are given. Wefind evidence for an attractive effective *d*-wave pairing interaction nearhalf-filling but have not found evidence for a phase transition to asuperconducting state.

46618 Structure of rubidium uranyl(VI) trinitrate. Zalkin, A. (Lawrence Berkeley Lab., CA (USA). Materials and Chemical Sciences Div.); Templeton, L.K.; Templeton, D.H. *Acta Crystallographica, Section C: Crystal Structure Communications (Denmark),* 45(5): 810-811 (15 May 1989). DOE Contract AC03-76SF00098.

$RbUO_2(NO_3)_3$, M_r=541.51, hexagonal, Ranti 3c, a=9.384(4), c=18.899(6) A, V=1441.3(14) A^3, Z=6, D_m=3.72, D_x=3.743(4) g cm^{-3}, Mo Kα, λ(α_1)=0.70930 A, μ=209.7 cm^{-1}, F(000)=1428, T=296 K, R=0.014 for 261 independent reflections with $I>2\sigma(I)$. The uranyl ion is coordinated in bidentate fashion by three nitrate ions in its equatorial plane. Bond lengths are U-O=1.746(4) (uranyl), 2.474(3) (nitrate), N-O=1.205(6) (terminal), 1.268(4) A (bridge). The anomalous-scattering term f' for U measured at 0.71 A is -10.7(2). (orig.).

46619 Multiple-scattering Green-function method for space-filling cell potentials. Gonis, A. (Division of Chemistry and Materials Science (L-280), Lawrence Livermore National Laboratory, Livermore, California 94551(US)); Zhang, X.; Nicholson, D. M. *Physical Review [Section] B: Condensed Matter (USA),* 40(2): 947-965 (15 Jul 1989). DOE Contract W-7405-ENG-48.

It is shown that the equations of multiple-scattering theory (MST)originally derived for scattering off collections of muffin-tin (MT)potentials, i.e., potential cells bounded by nonoverlapping spheres, remainvalid in the case of arbitrarily shaped, nonoverlapping, and particularlyspace-filling potential cells. Specifically, it is shown that in the angularmomentum representation the total scattering (transition) matrix, the Greenfunction, the Bloch function for a translationally invariant material, and theLloyd formula for the change in the integrated density of states have formsthat are invariant with respect to the partition of a given potential intononoverlapping cells, and with respect to the choice of the cell centers. Ananalytic proof is provided for the vanishing of near-field corrections (NFC's)long conjectured to arise when the spheres bounding individual cells overlapone another or adjacent potentials. Thus, the well-known MST expressions,originally derived for the case of MT potentials, for obtaining the solution ofthe Schrödinger equation and hence determining the band structure and thecharge density of materials, ordered or disordered, are rigorously valid in thecompletely general case of arbitrarily shaped cells. The differences betweenthis work and previous attempts to generalize MST to non-MT space-fillingpotentials are discussed. It is pointed out that in calculations involvingnon-MT potential cells, particular attention must be paid to the question ofconvergence of expansions in angular momentum eigenstates. This convergence istested numerically in terms of cluster calculations and through the calculationof the electronic structure of elemental bcc Nb and fcc Zr and Rh.

6561 Superconductivity

Refer also to citation(s) 45509, 45527, 45542, 45544, 45545, 45548

46620 (DOE/ER/45268–T1) **Studies of novel superconductors: Progress report, January 1, 1989–December 31, 1989.** Stewart, G.R. Florida Univ., Gainesville, FL (USA). Dept. of Physics. Aug 1989. 18p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER45268. Order Number DE89016744/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Important progress has been made in understanding the formation of the heavy fermion ground state via specific heat, susceptibility, and resistivity studies of $U_{1-x}M_xBe_{13}$, $0 \leq x \leq .995$ and M = Hf, Zr, Sc, Y, La, Ce, Pr, Lu and Th. The high effective mass, m*, in UBe_{13} was found to be caused both by single-ion effects, which contribute about 50% of the large specific heat $\gamma(\alpha\ m^*)$, and also by a many body correlation which depends on complete occupation of the U sites by U, i.e., the Kondo-lattice model. This is the first such demonstration of how the large m* ground state is formed in a heavy fermion compound. In the single-ion regime, we have found that it is the U-Be separation that is the controlling factor, not the effective U-U distance (α dilution) nor the identity of the doping metal M. Progress has also been made on other heavy fermion research projects, including the response of T_c in UPt_3 to "nonmagnetic" impurities, the T_c of "super-pure" UBe_{13}, and the behavior of C in high field of $CeCu_6$. Additionally, a new heavy fermion compound, $NpPt_4Au$, has been discovered, improving our understanding of the temperature dependence of the formation of m* at low temperatures. 5 figs.

46621 (IC–89/21) **Model of the isotope effect of the oxide superconductor.** Zhang Liyuan. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 7p. Order Number DE89635907/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

In this paper, a possible mechanism of producing negative correlation energy centers is proposed. Combining this electronic attractive potential with phonon mediated attractive potential between carriers the isotope effect exponent of La-Sr-Cu-O system is quantitatively explained. Generally, the isotope effect exponent is smaller than 1/2 in this mechanism. (author). 20 refs, 1 fig.

46622 (IC–89/39) **On the free carrier-negative U center interacting model for the high-T_c oxide superconductor.** Zhang Liyuan. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 8p. Order Number DE89635908/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Using the free carrier-negative U center interacting model, we have investigated the superconducting transition temperature (T_c), the specific heat jump at T_c, the coherence length, the penetration depth, the thermodynamic critical field and the isotope effect for the high-T_c oxide superconductor. The theoretical values of these physical quantities are consistent with the experimental values. Further, the residual electronic specific heat in the superconducting state is explained as the result of the inherent instability in this superconductive mechanism. (author). 26 refs.

46623 (IC–89/45) **Modified Ginzburg-Landau theory for anisotropic high temperature superconductors.** Shehata, L.N. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 23p. Order Number DE89635909/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The modified Ginzburg-Landau theory, MGL, for strongly anisotropic high temperature superconductors (HTSC's) is reviewed and the MGL equations are re-derived to be used in solving two important fundamental problems. The first one concerns the evaluation of the domain-wall energy problem by a complete solution of the derived equations. The modified free energy functional is used to calculate the maximum supercurrents in both HTSC's and the conventional superconductors. Our calculations show that the surface energy vanishes at the critical value of the GL parameter $\kappa_c = 1/\sqrt{2}\{(1-M)(1+M/3)\}^{1/2}$, where $0 \leq M < 1$. Therefore, the transformation from type II to type I superconductivity is possible at temperatures very close to the transition critical one, at which $\kappa(T)$ becomes zero. The generalized formulas of the superconducting current allowed us to calculate the maximum supercurrents for both the HTSC's and the conventional ones. The possible maximum currents are anisotropic and have higher values for HTSC's. Our results are in good agreement with the related theoretical works as well as with the experimental data. (author). 25 refs, 3 figs.

46624 (INIS-SU–94/A, pp. 30-31) **Transient Josephson effect on Y-Ba-Cu-O film at T=4.2 K.** Molchanov, I.B.; Rzaev, M.M. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012156/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

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Non-stationary Josephson effect T=4.2 K for intergrain structure of the Y-Ba-Cu-O film localized as a bridge with 30x180 μm^2 dimensions is obtained. Volt-ampere characteristics with stages induced by SHF radiation at different power levels are presented. 6 refs.; 3 figs.

46625 (JINR-N–4(30)-88, pp. 22-37) **Theoretical study of ultrasonic anomalies in $La_{2-x}Sr_xCuO_4$.** Aksenov, V.L. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics); Flakh, S.; Plakida, N.M. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

A microscopical model for description of acoustic properties at structural phase transition in $La_{2-x}Sr_xCuO_4$ superconductors is proposed. Experimentally observed acoustic anomalies are described in the framework of the model. 3 refs.; 1 fig.

46626 (JINR-N–4(30)-88, pp. 78-82) **Magnetization of $YBa_2Cu_3O_{7-x}$ ceramics after irradiation with carbon relativistic nuclei.** Gocharov, I.N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy); Omel'yanovskij, O.E. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. (In Russian). In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

R(T), chi(T) and M(B) of samples of $YBa_2Cu_3O_{7-x}$ ceramics were measured after irradiation with relativistic nuclei of fluorine and carbon (maximum fluence of $6{,}3x10^{12}$nucl./cm^2). The curves of R(T) and chi(T) for irradiated samples do not differ from those for an initial sample. At the same time the difference between M_- and M_+ and, consequently, the value of intragrain current density j_c pass via maximum located at the fluences less than $2x10^{12}$nucl./cm^2 (for the case when magnetic field is parallel to tracks). 11 refs.; 2 figs.

46627 (JINR-N–4(30)-88, pp. 83-86) **Stabilization of high-temperature superconductor $Y_1Ba_2Cu_3O_{7-\delta}$ surface.** Korenev, S.A.; Valentovic, D.; Lushchikov, V.I. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

A technique is suggested for stabilization of a high-temperature superconductor $Y_1Ba_2Cu_3O_{7-\delta}$ surface by means of a high-current pulsed electron beam (J=12,5-65 A/cm^2, E=70-200 keV, t=300 ns, P=0,001 Pa). The quality of the remelted surface film is characterized and first experimental results are discussed. It is shown that within 50 days after the electron beam processing, no dielectric film was developed at superconductor surface and superconductor characteristics did not change. 6 refs.; 4 figs.

46628 (JINR-N–4(30)-88, pp. 95-106) **Temperature dependence of critical current and I-V characteristics in the $YBa_2Cu_3O_7$(y) and $Bi_2S_2CaCu_2O_8$(Bi) ceramics.** Drobin, V.M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy); Dyachkov, E.I.; Trofimov, V.N. Joint Inst. for Nuclear Research, Dubna (USSR). 1988. In *JINR rapid communications. Collection of papers.* Order Number DE89012196/JAW. Available from NTIS (US Sales Only), PC A06/MF A01; INIS.

The temperature dependence of the transport critical current I_{cr} and the I-V characteristics (IVC) for Y and Bi ceramic samples has been measured. For 0,05 ->T/T_{cr}<1 , it was found that $I_{cr}\sim(T=c_r-T)^{\alpha}$ for both the types of high-T_c superconductors, with α=1,24 and 1,48 (two samples) for Y and α=2,58 for Bi. For the low voltage region of the IVC (V->I mV), voltage and current could be naturally normalized so that for the nondimensional quantites $U=i^{\gamma(T)}$ both for Bi and Y. At the same time a great dicrepancy in the temperature dependence of the characteristic parameters of the IVC fit point to a quite different process of transport current dissipation in Y and Bi. 10 refs.; 4 figs.

46629 (LA-UR–89-2564) **On the photoemission spectrum and optical gap in La_2CuO_4.** Martin, R.L. Los Alamos National Lab., NM (USA). 1989. 17p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890953–1: International conference on the physics of highly correlated electron systems, 11-15 Sep 1989). Order Number DE89015281/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The photoemission and optical spectrum of La_2CuO_4 are computed for a CuO_6 cluster model using the techniques of ab initio quantum chemistry. Evidence for a near degeneracy and strong electronic coupling between the configurations $Cu^{3+}O^{2-}$ (^{1}Ag) and $Cu^{2+}O^{1-}$ (^{1}Ag) is presented. This interaction leads to d^9 character at the Fermi energy as well as in the 12eV satellite. 17 refs., 1 fig., 2 tabs.

46630 (UCRL–101545) **Adaptation of the theory of superconductivity to the behavior of oxides.** Teller, E. Lawrence Livermore National Lab., CA (USA). Jul 1989. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8905143–11: NATO international advanced course on the nuclear equation of state, 12 May - 3 jun 1989). Order Number DE89016518/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An adaptation of the conventional theory to high-temperature superconductors is proposed. Excitation of electrons from below the Fermi surface to above the Fermi surface (according to Bardeen, Copper and Schrieffer) is replaced by excitation from a filled energy band into an empty one. The energy bands are constructed from two-dimensional Bloch functions in neighboring layers of the oxide lattices. Strong coupling with lattice displacements is due to the removal of the topmost electrons from the O^{2-} ions in the perovskite planes. The main methods of the BCS theory are retained. The formation and observability of a super-lattice is discussed.

46631 Order of phase transition in high temperature superconductivity. Lee, T.D. (Columbia Univ., New York, NY (USA)). *Modern Physics Letters B (USA),* 3(2): 135-139 (Feb 1989).

The authors present arguments that the phase transition in some of the newly discovered high temperature superconductors is first-order, unlike the usual Λ-transition.

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Refer also to citation(s) 46024, 46455, 46484, 46494, 46506, 46734

46632 (AD-A–207798/0/XAB) **Problem of selecting the shape functions for a p-type finite element. Final report.** Babuska, I.; Griebel, M.; Pitkaranta, J. Maryland Univ., College Park, MD (USA). Inst. for Physical Science and Technology. Nov 1988. 40p. (BN–1090). Available from NTIS, PC A03/MF A01.

Also available as Rept. nos. MD88-36-IB-MG-JP and TR88-36.

This paper addresses the question of the optimal selection of the shape functions for p-type finite elements and discusses the effectivity of the conjugate-gradient and multilevel-iteration method for solving the corresponding linear system. The selection of the shape functions is of major importance for the performance of the solver based on iterative methods. Neither the theory nor practice of the optimal selection of the shape functions is available yet. We have seen that the condensation approach which has obvious advantages from the point of parallel computations is a very effective tool for keeping the condition number under the control and is especially advantageous for the conjugate gradient method.

46633 (AD-A–208103/2/XAB) **Quantization by cosmic-background radiation. Technical report.** Dehn, J.T. Army Armament Research and Development Command, Aberdeen Proving Ground, MD (USA). Ballistics Research Lab. May 1989. 27p. (BRL-TR–2991). Available from NTIS, PC A03/MF A01.

This paper suggests that various modes in the cosmic-background radiation field may account for the discrete properties exhibited by small systems. In particular, this view is applied to the one-, two-, and three- dimensional oscillators and the hydrogen atom, systems which were treated by Schroedinger in his first papers on quantum mechanics. The usual energy formulas for the above systems are derived using this point of view, together with some indication of how transition probabilities might also be calculated. A connection between de Broglie's associated wave and a free mass moving in the cosmic background is also discussed. Analogs of the uncertainty and correspondence principles are briefly mentioned as are some of the implications this view might have for interpreting quantum theory. In this view particles and waves are separate, interacting entities and not complementary aspects of the same thing.

46634 (ANL/MCS-TM–133) **The bidiagonal singular value decomposition and Hamiltonian mechanics: LAPACK working note No. 11.** Deift, P.; Demmel, J.; Li, Luen-Chau; Tomei, C. Argonne National Lab., IL (USA). Mathematics and Computer Science Div. Aug 1989. 66p. Sponsored by ANL;DOE/ER;NSF. DOE Contract W-31109-ENG-38. DMS-8802305;DCR-8552474;ASC-8715728;DMS-8704097. Order Number DE89016545/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

We consider computing the singular value decomposition of a bidiagonal matrix B. This problem arises in the singular value decomposition of a general matrix, and in the eigenproblem for a symmetric positive definite tridiagonal matrix. We show that if the entries of B are known with high relative accuracy, the singular values and singular vectors of B will be determined to much higher accuracy than the standard perturbation theory suggests. We also show that the algorithm computes the singular vectors as well as the singular values to this accuracy. We also give a Hamiltonian interpretation of the algorithm and use differential equation methods to prove many of the basic facts. The Hamiltonian approach suggests a way to use flows to predict the accumulation of error in other eigenvalue algorithms as well. 36 refs., 2 figs., 2 tabs.

46635 Diffraction contrast of a Bragg-Fresnel lens in white and monochromatic radiation. Aristov, V.V. (Institute of Problems of Microelectronics Technology and High Purity Materials, Chernogolovka (USSR)); Basov, Yu.A.; Frahm, R.; Graeff, W.; Materlik, G.; Snigirev, A.A. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

Recent advances in the studies of x-ray diffraction phenomena and the technology of structures with elements up to hundreds of angstroms in size open up possibilities for fabrication of effective

x-ray focusing elements with three-dimensional Fresnel zone structures, namely, Bragg-Fresnel lenses (BFL). BFL differs favorably from the Fresnel zone plate by the absence of chromatic aberrations which is due to the high spectral selectivity of Bragg reflection, $\Delta\lambda/\lambda \sim 10^{-4} \div 10^{-5}$. This enables observation of focusing and image transmission in the white spectrum of synchrotron radiation (SR). 7 refs., 7 figs.

46636 (IC–87/358(Rev.)) **Inner product for a Banach-algebra.** Mohammad, N.; Verjovsky, A. International Centre for Theoretical Physics, Trieste (Italy). Jul 1988. 8p. Order Number DE89635692/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

An inner product is defined on a commutative Banach algebra with an essential involution and the resultant inner product space is shown to be a topological algebra. Several conditions for its completeness are established and moreover, a decomposition theorem is proved. It is shown that every commutative Banach algebra with an essential involution has an auxiliary norm which turns it into an A*-algebra. (author). 6 refs.

46637 (IC–88/411) **Qualitative analysis of nonlinear incidence rate upon the behaviour of an epidemiological model.** Li Xiaogui. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 6p. Order Number DE89635693/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Two theorems concerning the solutions of the system of differential equations describing an epidemiological model with nonlinear incidence rate per infective individual are demonstrated. 2 refs, 1 fig.

46638 (IC–89/35) **Quantum consistency of a gauge-invariant theory of a massive spin-3/2 particle interacting with external fields.** Rindani, S.D. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 15p. Order Number DE89635702/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A gauge-invariant theory of a massive spin-3/2 particle interaction with external electromagnetic and gravitational fields, obtained earlier by Kaluza-Klein reduction of a massless Rarita-Schwinger theory, is quantized using Dirac's procedure. The field anticommutators are found to be positive definite. The theory, which was earlier shown to be free from the classical Velo-Zwanziger problem of noncausal propagation modes, is thus also free from the problem of negative-norm states, a long-standing problem associated with massive spin-3/2 theories with external interaction. (author). 19 refs.

46639 (IC–89/40) **Langevin formulation of quantum dynamics.** Roncadelli, M. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 11p. (CERN-TH–5360/89). Order Number DE89635703/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We first show that nonrelativistic quantum mechanics formulated at imaginary-(h/2 π) can formally be viewed as the Fokker-Planck description of a frictionless brownian motion, which occurs (in general) in an absorbing medium. We next offer a new formulation of quantum mechanics, which is basically the Langevin treatment of this brownian motion. Explicitly, we derive a noise-average representation for the transition probability W(X",t"—X',t'), in terms of the solutions to a Langevin equation with a Gaussian white-noise. Upon analytic continuation back to real-(h/2 π),W(X",t"—X',t') becomes the propagator of the original Schroedinger equation. Our approach allows for a straightforward application to quantum dynamical problems of the mathematical techniques of classical stochastic processes. Moreover, computer simulations of quantum mechanical systems can be carried out by using numerical programs based on the Langevin dynamics. (author). 19 refs, 1 tab.

46640 (IC–89/42) **Covariant linear oscillator and generalized realization of the dynamical SU(1,1) symmetry algebra.** Kagramanov, E.D.; Nagiyev, Sh.M.; Mir-Kasimov, R.M. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 24p. Order Number DE89635704/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An exactly soluble problem for the finite-difference Schroedinger equation in the relativistic configurational space is considered. The appropriate finite-difference generalization of the factorization method is developed. The theory of new special functions "the relativistic Hermite polynomials", in which the solutions are expressed, is constructed. (author). 14 refs.

46641 (IC–89/46) **Blow-up and global existence for heat flows of harmonic maps.** Chen Yunmei; Ding Weiyue. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 16p. Order Number DE89635694/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

In this paper it is proved that the solution to the evolution problem for harmonic maps blows up in finite time, if the initial map belongs to some nontrivial homotopy class and the initial energy is sufficiently small. However, the solution exists globally in time and subconverges to a constant map, if the initial energy density is bounded by a constant and the initial energy is sufficiently small, depending on this constant. (author). 20 refs.

46642 (IC–89/48) **Supergrassmannians, super tau-functions and strings.** Dolgikh, S.N.; Schwarz, A.S. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 17p. Order Number DE89635695/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Recently, infinite-dimensional grassmannians and their supergeneralizations were used to study conformal two-dimensional fields and strings. In particular, the super Mumford form (holomorphic square root from the superstring measure on moduli space) was expressed through super analog of Sato tau-function. In this paper we present results of supergrassmannians and super tau-functions. 8 refs.

46643 (IC–89/53) **Continuity of conditional expectations.** Brambila-Paz, F.; Alonso, A. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 7p. Order Number DE89635696/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

A condition over a sequence A_n of σ-subalgebras that assures L^p-convergence of the conditional expectations will be given. This condition is more general than the Martingale theorem condition and the O'Reilly-Fetter condition. (author). 3 refs.

46644 (IC–89/54) **On the automorphisms of foliations defined by complex linear vectorfields.** Shahshahani, S. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 14p. Order Number DE89635697/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We study biholomorphisms of C^n that preserve the foliation associated to a complex linear vector fields. It is shown that for hyperbolic Poincare vector fields the only such biholomorphisms are linear. Nonlinear biholomorphisms emerge in the presence of resonance among the eigenvalues of the system. A complete classification is given in dimension 2. (author). 8 refs, 1 fig.

46645 (IC–89/55) **Continuum analogues of contragredient Lie algebras. Lie algebras with a Cartan operator and nonlinear dynamical systems.** Saveliev, M.V.; Vershik, A.M. International Centre for Theoretical Physics, Trieste (Italy). Mar 1989. 14p. Order Number DE89635698/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We present an axiomatic formulation of a new class of infinite-dimensional Lie algebras - the generalizations of Z-graded Lie algebras with, generally speaking, an infinite-dimensional Cartan subalgebra and a contiguous set of roots. We call such algebras "continuum Lie algebras". The simple Lie algebras of constant growth are encapsulated in our formulation. We pay particular attention to the case when the local algebra is parametrized by a commutative algebra while the Cartan operator (the generalization of the Cartan matrix) is a linear operator. Special examples of these algebras are the Kac-Moody algebras, algebras of Poisson brackets, algebras of vector fields on a manifold, current algebras, and algebras with differential or integro-differential Cartan operator. The nonlinear dynamical systems associated with the continuum contragredient Lie algebras are also considered. (author). 9 refs.

46646 (IC–89/67) **Flow of harmonic applications of a compact variety on a bordered variety.** Chen Yunmei; Musina, R. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 5p. (In French). Order Number DE89635699/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

If M is a compact riemannian variety and C a riemannian variety closed to border, a weak harmonic application μ:M->C is defined as being a solution of a differential inclusion. We present a theorem of existence and partial regularity for the weak solution of the evolution inclusion for harmonic applications. This solution converges to a weak harmonic application when the time tends appropriately to infinity. 10 refs.

46647 (IC–89/72) **Chern-Simons theories of symplectic super-diffeomorphisms.** Sezgin, E.; Sokatchev, E. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 12p. Order Number DE89635700/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We discuss the symplectic diffeomorphisms of a class of supermanifolds and the structure of the underlying infinite dimensional superalgebras. We construct a Chern-Simons (CS) gauge theory in 2+1 dimensions for these algebras. There exists a finite dimensional supersymmetric truncation which is the (2^n-1)-dimensional Hamiltonian superalgebra H-tilde(n). With a central charge added, it is a superalgebra, C(n), associated with a Clifford algebra. We find an embedding of d=3, N=2 anti-de Sitter superalgebra OSp(2—2)+OSp(2—2) in C(4), and construct a CS action for its infinite dimensional extension. We also discuss the construction of a CS action for the infinite dimensional extension of the d=3, N=2 superconformal algebra OSp(2,4). (author). 18 refs.

46648 (IC–89/73) **Lefschetz trace formula and BRST.** Schwarz, A. International Centre for Theoretical Physics, Trieste (Italy). Apr 1989. 7p. Order Number DE89635705/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

Quantum systems with constraints showing how the BRST-transformation and the BFV-method of quantization can be understood directly in this case are studied in this paper. The results concerning the quantization of classical constrained systems can be derived from the results for quantum systems. 7 refs.

46649 (IC–89/84) **Modular invariants for theta-functions with characteristics and the twisted N=2 superconformal and SU(2) Kac-Moody algebras.** Dobrev, V.K.; Ganchev, A.H. International Centre for Theoretical Physics, Trieste (Italy). May 1989. 16p. Order Number DE89635701/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

We classify the modular invariants for θ-functions with characteristics relevant for the twisted N=2 super-Virasoro and the twisted SU(2) Kac-Moody algebras. Detailed and complete proofs are given. Based on this we give the classification of the modular invariants for the above algebras. (author). 26 refs.

46650 (INIS-BR–1571) **Microscopy of bosonic models using Schwinger and Holstein - Primakoff bosonization techniques.** Pinto, M.E.B. Sao Paulo Univ., SP (Brazil). Inst. de Fisica. 1988. 53p. (In Portuguese). Order Number DE89635706/JAW. Available from NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS.

Two kinds of bosonic expansions for the SU(2) case, one being finite (Schwinger) and the other being infinite (Holstein-Primakoff) are analysed. The existence of a transformation connecting them was discussed. Utilizing the two methods, the Two Level Model hamiltonian into the many boson space is mapped. Considering systems composed by 4, 6 and 14 particles, calculations for the eigenenergies within the "vibrational limit" of the model were performed. The results show that the Schwinger mapping is exact. Approximated bosonic images with the Holstein-Primakoff mapping are obtained. Indeed, the anharmonicities observed in the region between the ideal " spherical limit" and the "transitional point", were well described by the approximation containing up to quartic terms on the bosonic operators. (author).

46651 (INIS-SU–94/A, pp. 25-27) **On some properties of energy levels in complex region.** Ushveridze, A.G. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Experimental and theoretical physics.* Order Number DE89012156/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

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Applicability of the electrostatic analog problem and the nonstandard theory of perturbations for investigation of spectral Riemann varieties in models of quantum mechanics is discussed. 5 refs.

46652 (LA-UR–89-2656) **Magnetic flux compression.** Fowler, C.M. Los Alamos National Lab., NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-890812–30: American Physical Society topical conference on shock compression of condensed matter, 14-17 Aug 1989). Order Number DE89016991/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Magnetic Flux Compression, as treated in this paper, is accomplished by high explosives. Flux is first captured in a closed conducting circuit, of which some or all of the conducting elements are overlaid with high explosives. Upon detonation of the explosives, these elements are driven in such a fashion as to compress the flux into regions of smaller areas or, in engineering terminology, into regions of lower inductance. The magnetic energy associated with the flux is increased by the flux compression. The additional energy is ultimately supplied by the explosive as it drives the conductors against the magnetic field pressure, which in some cases may be in the megabar range. Various names in common use for flux compression devices are flux compression generators (FCG), magneto-cumulative generators (MCG), particularly in the USSR, or simply, flux compressors. FCGs are generally used in two broadly defined categories: as compact, high-power sources to drive various loads: and as generators of very large magnetic fields. In this talk, general principles of flux compression are first discussed. This is followed by a description of several applications in which different types of FCGs are used to supply pulsed power to various devices. The talk closes with a discussion of results obtained from a number of experiments done to explore the properties of materials in very large magnetic fields or under nearly isentropic compression. As requested, the work reported here surveys the Los Alamos program. However, sources cited in the bibliography contain much of the extensive literature in the field. Individual papers cited have been selected partly to highlight other groups that have been active in the field. 25 refs., 15 figs.

46653 (LNCC–018/88) **On scattering by time-dependent potentials: the 2-D case.** Ferreira, J.A.; Menzala, G.P. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). May 1988. 29p. Order Number DE89635708/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A real potential q(x,t) which has compact support in space x epsilon IR^2 and it is "damped" is considered. The solutions of U sub (tt) $-\Delta u + q(x,t)u = 0$ showing that under additional technical assumptions on q the scattering operator exists are studied. The proofs are elementary. (author).

46654 (LNCC–019/88) **On the superconvergence of the SBB method.** Franca, L.P. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). May 1988. 29p. Order Number DE89635709/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Written in a mixed form a simple two-point boundary value problem is shown to have superconvergence characteristics under the SBB method. Convergence and accuracy analyses reveal superior performance of the method compared to the usual Galerkin method. (author).

46655 (LNCC–021/88) **Recent applications of classical mechanics to pure and applied mathematics.** Koiller, J. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Jun 1988. 23p. (In Portuguese). Order Number DE89635710/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

A mixed bag of results and recent articles in Symplectic Geometry and Hamiltonian Mechanics, emphasizing the interaction with several areas of Pure and Applied Mathematics, is presented. (author).

46656 (LNCC–022/88) **Algorithm to compute the square root of 3x3 positive definite matrix.** Franca, L.P. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Jun 1988. 26p. Order Number DE89635711/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

An efficient closed form to compute the square root of a 3 x 3 positive definite matrix is presented. The derivation employs the Cayley-Hamilton theorem avoiding calculation of eigenvectors. We show that evaluation of one eigenvalue of the square root matrix is

needed and can not be circumvented. The algorithm is robust and efficient. (author).

46657 (LNCC–033/88) **Uniform stability for time-varying infinite-dimensional discrete linear systems.** Kubrusly, C.S. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Sep 1988. 31p. Order Number DE89635712/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Stability for time-varying discrete linear systems in a Banach space is investigated. On the one hand, it established a fairly complete collection of necessary and sufficient conditions for uniform asymptotic equistability for input-free systems. This includes uniform and strong power equistability, and uniform and strong ^{l}p - equistability, among other technical conditions which also play essential role in stability theory. On other hand, it is shown that uniform asymptotic equistability for input-free systems is equivalent to each of the following concepts of uniform stability for forced systems: ^{l}p -input ^{l}p -state, c_o-input c_o-state, bounded-input bounded-state, $^{l}p>1$ -input bounded-state, c sub (o)-input bounded-state, and convergent-input bounded-state; which are also equivalent to their nonuniform counterparts. For time-varying convergent systems, the above is also equivalent to convergent-input convergent-state stability. The proofs presented here are all "elementary" in the sense that they are based essentially only on the Banach-Steinhaus theorem. (autor).

46658 (LNCC–036/88) **Asymptotic behaviour of solutions of a degenerate quasilinear hyperbolic equation.** Pereira, D.C. Laboratorio Nacional de Computacao Cientifica, Rio de Janeiro, RJ (Brazil). Oct 1988. 12p. Order Number DE89635713/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

The decay as $t->\infty$ of the solutions of equation $u''(t)-A^{1/2}u(t)-^{2}Au(t)+Au'(t)=0$ where A is a self-adjoint operator in a Hilbert space H with norm —.— is studied. A decay of algebraic rate for the energy associated to the studied equation is obtained. (author).

46659 (NBI-HE–89-25) **The appearance of matter fields from quantum fluctuations of 2D-gravity.** Kazakov, V.A. Niels Bohr Inst., Copenhagen (Denmark). May 1989. 15p. Order Number DE89915282/JAW. Available from NTIS (US Sales Only), PC A03/MF A01.

It is established that various critical regimes may occur for a model of two-dimensional pure quantum gravity. These regimes correspond to the presence of effective fields with scaling dimensions $\Delta_k=-\gamma_{str}.k/2$, k=1, 2, 3 ..., where $\gamma_{str}=-1/m$, m=2, 3, 4 ... is the critical exponent of 'string susceptibility' (with respect to the cosmological constant). This behaviour is typical for unitary conformal fields with the central charge $c=1-6/[m(m+1)]$ in the presence of 2D-quantum gravity. We use the framework of loop equations for the invariant boundary functional, which are exactly solvable in this case. (orig.).

46660 (SAND–89-7101C) **Electromagnetic scattering from multiple cylinders using the bymoment method.** Lee, R.; Cangellaris, A.C. Arizona Univ., Tucson, AZ (USA). Electromagnetics Lab. 14 Jul 1989. 16p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8901135–1: Institute of the Union of Radio Science scientist and engineers student contest, 3-7 Jan 1989). Order Number DE89015888/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

We apply the bymoment method to the problem of electromagnetic scattering from multiple cylinders. The bymoment method uses Green's theorem to couple the finite-element solution inside and around each of the cylinders to the exterior region. This method allows us to enclose each cylinder by its own individual mesh, resulting in an enormous computational and memory savings. Numerical results for several cases are presented and compared to series solutions available in the literature. 9 refs., 10 figs.

46661 (UCRL–101506) **Computations of the refraction of a plane shock wave at a slow-fast gas interface.** Puckett, E.G.; Colella, P.; Henderson, L.F. Lawrence Livermore National Lab., CA (USA). 14 Jul 1989. 6p. Sponsored by DOD;DOE/ER. DOE Contract W-7405-ENG-48. IACRO-88-873. (CONF-890756–1: 17. international symposium on shock waves and shock tubes (STS-17), 17-21 Jul 1989). Order Number DE89016508/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We present an example of our computations on a shock wave refracting from CO_2 into CH_4. The results are compared with the experiments of Abdel-Fattah and Henderson. Our input data were the same as the parameters they measured and we used the same boundaries. We also took into account the mutual gas contamination present in the experiments and the effects of a separating membrane. All the principal properties of a free-precursor refraction were detected. 6 refs., 4 figs., 1 tab.

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46662 (EGG-M–89203) **An investigation of energy balances in palladium cathode electrolysis experiments.** Longhurst, G.R.; Dolan, T.J.; Henriksen, G.L. EG and G Idaho, Inc., Idaho Falls, ID (USA). 19 May 1989. 30p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC07-76ID01570. (CONF-8905126–4: Workshop on cold fusion phenomena, 23-25 May 1989). Order Number DE89016268/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In recently publicized cold fusion experiments at the University of Utah, generation of excess heat was reported. To investigate mechanisms that may contribute to energy flows in electrolysis cells, a series of experiments was performed at the Idaho National Engineering Laboratory (INEL). Ordinary water (H_2O), heavy water (D_2O), and mixture of the two were used in the INEL experiments. Cathodes used include a 51-μm Pd foil and 1-mm diameter extruded wire Pd rods in two configurations. Energy balances in these experiments revealed that some of the required voltage to sustain a given current is due to irreversibilities associated with cell operation. Particularly significant are electrolyte resistance and activation energy polarization effects. Energy balances in the INEL experiments showed there was no significant net grain or net loss of energy. Cell overpotential curves were fit well with a Tafel equation, with parameters dependent on electrode configuration, electrolyte composition, and temperature. Water evaporation and interactions of hydrogen isotopes with the Pd cathode were evaluated and found not to be significant to energy balances. No ionizing radiation, tritium production, or other evidence of fusion reactions was seen in the INEL experiments. 4 refs., 6 figs., 2 tabs.

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Refer also to citation(s) 45792, 45826, 46399, 46724

46663 (AD-A–207952/3/XAB) **Plasma theory and simulation. Quarterly progress report Nos. 1-2, 1 January-30 June 1988.** Birdsall, C.K. California Univ., Berkeley, CA (USA). Electronics Research Lab. 30 Jun 1988. 38p. Available from NTIS, PC A03/MF A01.

Sponsored in part by Contract DE-AC03-87ER53254.

A magnetized plasma next to an absorbing wall is simulated, showing positive wall charging causing a large E-field near the wall, than a large ExB drift, then a Kelvin-Helmholtz instability, vortices, and coalescence. Particle transport to the walls is Bohm-like, for omega sub pi > omega sub ci. Plasma transport across B_o to a wall is studied without and with an active antenna buried in the wall. Particle losses are increased appreciably by the fields of the antenna. Small-angle Coulomb collisions produce a drag force and diffusion tensor, which are calculated self-consistently. This produces a FP-PIC method. An example is shown for a beam scattering off fixed ions. Implicit particle simulations are discussed for bounded plasma. The effect of source distribution on the sheath potential is discussed. Initiation of an effort to simulate a traveling-wave tube is discussed. Substantial progress was made in making the authors standard periodic code ES1 work efficiently on a fast PC. A plasma sheath reference listing is discussed.

46664 (AD-A–207975/4/XAB) **Effects of magnetic and collisional viscosity on the E x B gradient drift instability. Memorandum report.** Zalesak, S.T.; Huba, J.D.; Satyanarayana, P. Naval Research Lab., Washington, DC (USA). 27 Apr 1989. 43p. (NRL-MR–6438). Available from NTIS, PC A03/MF A01.

The role of magnetic viscosity (i.e., Larmor radius effects) and collisional viscosity on the ExB gradient drift instability is investigated in both the collisional and inertial regimes. The equations describing the time evolution of small perturbations to an equilibrium two dimensional (x,y) magnetized plasma are derived where the equilibrium electron density is an arbitrary function of y. The equations are then solved iteratively in time to obtain the growth rate of the fastest-growing eigenmode for a given Fourier wavenumber k in the x direction. Results are compared for appropriate profiles with two asymptotic results: the long-wavelength limit, valid for kL less than 1, and the short-wavelength or local limit, valid for kL greater than 1, where L is the gradient scale length of the equilibrium profile. It is found that although the long- and short-wavelength limits do indeed provide accurate growth rates for kL less than 1 and kL greater than 1, respectively, neither provides reliable growth rates for kL approx. 1. In comparing these results to the long-wavelength limit, in addition to affecting gamma in an absolute sense, increasing L to a finite value decreases k sub max, the value of k for which gamma(k) maximizes, and also affects the sharpness of the peak of gamma(k) about k sub max. Both of these phenomena have large effects on freezing models.

46665 (CONF-890931–1) **Hybrid particle-fluid approach to low-frequency turbulence in magnetically confined plasmas.** Leboeuf, J.N.; Fowler, R.H.; Han, J.H.; Lyster, P.M. Oak Ridge National Lab., TN (USA). [1989]. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. conference on the numerical simulation of plasmas; 17-20 Sep 1989. Order Number DE89015904/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have developed a hybrid particle-fluid computer model for quasineutral microinstabilities in magnetically confined plasmas. The ions are treated in the fluid approximation. The electrons are taken as guiding-center macroparticles. The model has been extensively tested for frequency and fluctuation spectra. Linear and nonlinear studies of drift waves, η_i modes, interchange modes, and trapped electron modes have also been carried out. 4 refs., 3 figs.

46666 (CONF-890931–2) **Three-dimensional equilibria and Mercier stability calculations.** Lynch, V.E.; Dominguez, N.; Carreras, B.A.; Varias, A.; Alejaldre, C.; Fraguas, A.L. Oak Ridge National Lab., TN (USA). 1989. 4p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 13. conference on the numerical simulation of plasmas; 17-20 Sep 1989. Order Number DE89015907/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

It is well known that an equilibrium to be used for stability calculations must be extremely accurate. These high accuracy requirements, in a fixed boundary calculation, are translated into high accuracy in the representation of the boundary. These requirements are even stricter for stellarator configurations, for which all the information about the magnetic configuration is given externally through the boundary. Many Fourier components are required to accurately represent the boundary input from a realistic coil system. For torsatron-type configurations, as many as 50 components can be needed to describe the last closed magnetic surface for the vacuum field. For a heliac configuration, the number of components can go up to 200. For 3-D calculations, there is another question of accuracy that does not apply to stability calculations for axisymmetric systems. This is the role of resonant components in the calculation of the geodesic curvature or the Pfirsch-Schlueter current. As Boozer argues, local flattening of the pressure profile eliminates the singularities generated by the resonant components. However, to implement it in a numerical calculation and to eliminate the resonant components, it is necessary to work in a coordinate system with straight magnetic field lines. This creates another problem, since the equilibrium representation in a straight magnetic field lines coordinate system requires many more components than the optimal equilibrium representation developed by Hirshman and co-workers over the last decade and implemented in the VMEC equilibrium code. In this paper, we use the VMEC equilibrium code and tranform the results to the straight magnetic field line coordinate system to calculate the input for the stability analysis. The accuracy of the transformation and the convergence of the equilibrium in the new coordinate system are the major points discussed in this paper. 6 refs., 1 fig.

46667 Observations of high density plasmas produced with a picosecond high power KrF laser. Willi, O. (Imperial College of Science and Technology, London (England)); Kiehn, G.; Edwards, J.; Barrow, V.; Smith, R. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

The interaction of a single picosecond, high power KrF laser pulse with solid targets has been studied using time integrated and time resolved x-ray spectroscopy. Fully ionized aluminum plasmas with temperatures of about 400 eV and densities well above 10^{23} cm^{-3} were observed when the ASE prepulse was less than 10^{-5}. 5 refs., 8 figs.

46668 Characteristics of a non-equilibrium picosecond laser plasma. Gibson, G. (Univ. of Illinois, Chicago (USA)); Rosman, R.; Luk, T.S.; McIntyre, I.A.; McPherson, A.; Wendin, G.; Boyer, K.; Rhodes, C.K. pp. 436 of Short wavelength coherent radiation: Generation and applications. Proceedings: Volume 2. Falcone, R.W.; Kirz, J. Optical Society of America, Washington, DC (1988). From 4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988.

VUV spectra of a highly ionized argon plasma produced by a high-power subpicosecond laser are analyzed to determine the electron temperature. The calculated electron temperature is too low to support the highest observed charge state, showing the plasma charge state distribution to be out of Saha equilibrium. 16 refs., 6 figs.

46669 (CONF-8908109–1) **Calibration of neutron detectors at the ORNL Advanced Toroidal Facility.** England, A.C.; Sumner, J.N.; Young, K.G. Oak Ridge National Lab., TN (USA). [1989]. 13p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Neutron calibration techniques workshop; 1-3 Aug 1989. Order Number DE89015355/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The ion temperature in a maxwellian plasma containing deuterium ions can be determined by measuring the neutron rate from the plasma. This rate, coupled with a measurement of the ion density, and a measurement of the fraction of the ions that are deuterium, allows a direct determination of the ion temperature since the cross section for neutron production as a function of temperature is well known. This technique has been applied to several tokamaks and at least one stellarator and will be employed in the Advanced Toroidal Facility (ATF). ATF is a stellarator with a major radius of 2.1 m and an average minor radius of 0.27 m. The plasma in ATF is produced by microwave power at the electron cyclotron frequency. The ions are heated by hydrogen neutral beam injection with a total power $\gtrsim$2 MW, and rf power at the ion cyclotron frequency. The ATF facility has nine moderated thermal neutron detectors arrayed around its exterior in order to accurately monitor the neutron rate. The various detectors have differing efficiencies in order to allow for a wider variation in neutron source strength before count rates and statistical uncertainties limit the temperature determination. A ^{252}Cf source was inserted into ATF on the midplane of the vacuum chamber at 24 locations at a major radius of 2.1 m in order to give a good toroidal average of the count rate of the nine detectors. Each detector was calibrated to give an efficiency which is defined as the ratio of the toroidal average of the count rate to the californium source strength. When ATF operates with deuterium gas these efficiencies will be used to measure the ion temperature in the range of ~500 eV to several keV. 5 refs., 3 figs., 1 tab.

46670 (DOE/ER–0421) **Review of computer applications in the Magnetic Fusion Energy Theory Program.** USDOE Office of Energy Research, Washington, DC (USA). Applied Plasma Physics Div. Jul 1989. 22p. Sponsored by U.S. DOE Energy Research. Order Number DE89015617/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Computing plays a very important role in the magnetic fusion program, not only in theoretical studies, but in experimental and engineering work as well. Over a decade ago, the MFE program could proudly boast that it was on the cutting edge of computational

physics in such diverse areas as particle-in-cell simulation, nonlinear multidimensional MHD simulation, and Fokker-Planck calculations. New problems were being attacked and new computational methods developed in a very active and productive environment. Despite the fact that the MFE program faces enormous computational challenges, it is no longer in the vanguard of research and development in computational physics. The computational effort has lost its leadership position because it has suffered, along with the theory program in general, from a steady reduction in support. This report presents the findings and recommendations of the Committee for the Review of Computer Applications in the MFE Theory Program that was formed under the auspices of the Division of Applied Plasma Physics of the Office of Fusion Energy (OFE) of the US Department of Energy. The purpose of the review was to assess the status of computing in the theory program, examine the effectiveness with which computing resources are being used, and project the computing needs of the theory program for the future.

46671 (DOE/ER/53212–142) **Boundary effects on the MHD dynamo in laboratory plasmas.** Ho, Y.L.; Prager, S.C. Wisconsin Univ., Madison, WI (USA). Plasma Physics Research. Jul 1989. 11p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-85ER53212. (CONF-8908112–1: IUTAM symposium on topological fluid mechanics, Aug 1989). Order Number DE89015207/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In recent laboratory experiments, a dynamo-like mechanism has been demonstrated in which a portion of the axisymmetric component of the magnetic field is believed to be sustained by 3D spatial fluctuations in the field and flow. With a conducting shell at the plasma surface, past MHD computation shows that sustainment arises from fluctuations which cause magnetic reconnection. If the conducting wall is retracted from the plasma surface, the fluctuations are amplified and the dynamo sustainment is still active for the times studied, but an increased energy input to the plasma is required through the applied electric field. The retraction of the conducting wall enhances the helicity dissipation rate by the intersection of the fields with the resistive surface which bounds the plasma. This enhanced helicity dissipation is balanced by the helicity injection that accompanies the increased applied electric field. 17 refs., 7 figs., 1 tab.

46672 (DOE/ER/53217–3) **Theoretical atomic physics for fusion: Annual report, 1989.** Pindzola, M.S. Auburn Univ., AL (USA). Dept. of Physics. 1989. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-86ER53217. Order Number DE89017363/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Electron-ion collision processes play a major role in many plasma research efforts to understand particle and energy transport in magnetic fusion experiments. We summarize our 1989 efforts in several areas of electron-ion scattering theory in this paper. 11 refs.

46673 (DOE/ER/53218–10) **Fusion plasma theory grant: Task 1, Magnetic confinement fusion plasma theory: Annual report covering the period November 16, 1988 to November 15, 1989.** Callen, J.D. Wisconsin Univ., Madison, WI (USA). Dept. of Nuclear Engineering and Engineering Physics. Jul 1989. 17p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-86ER53218. Order Number DE89017315/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The research performed under this grant during the current year has concentrated on key tokamak plasma confinement and heating theory issues: further development of neoclassical MHD; development of a new fluid/kinetic hybrid model; energy confinement degradation due to macroscopic phenomena in tokamaks; and some other topics (magnetics analysis, coherent structures, presheath structure). Progress and publications in these areas are briefly summarized in this report. 20 refs.

46674 (DOE/ER/53257–2) **Ion temperature gradient instability: Progress report.** Columbia Univ., New York, NY (USA). [1989]. 3p. Sponsored by U.S. DOE Energy Research. DOE Contract FG02-87ER53257. Order Number DE89016574/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

Anomalous ion thermal conductivity remains an open physics issue for the present generation of high temperature Tokamaks. It is generally believed to be due to Ion Temperature Gradient Instability (η_i mode). However, it has been difficult, if not impossible to identify this instability and study the anomalous transport due to it, directly. Therefore the production and identification of the mode is pursued in the simpler and experimentally convenient configuration of the Columbia Linear Machine (CLM). CLM is a steady state machine which already has all the appropriate parameters, except η_i. This parameter is being increased to the appropriate value of the order of 1 by 'feathering' a tungsten screen located between the plasma source and the experimental cell to flatten the density profile and appropriate redesign of heating antennas to steepen the ion temperature profile. Once the instability is produced and identified, a thorough study of the characteristics of the mode can be done via a wide range of variation of all the critical parameters: η_i, parallel wavelength, etc.

46675 (DOE/ER/53266–25) **Kinetic effects in Alfven wave heating Part 2 propagation and absorption with a single minority species.** Li, Wann-Quan; Ross, D.W.; Mahajan, Swadesh M. Texas Univ., Austin, TX (USA). Fusion Research Center. Jun 1989. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-88ER53266. (FRCR–337). Order Number DE89016619/JAW. Available from NTIS, PC A03/MF A01; OTI; GPO Dep.

Kinetic effects of Alfven wave spatial resonances near the plasma edge are investigated numerically and analytically in a cylindrical tokamak model. In Part 1, cold plasma surface Alfven eigenmodes (SAE's) in a pure plasma are examined. Numerical calculations of antenna-driven waves exhibiting absorption resonances at certain discrete frequencies are first reviewed. From a simplified kinetic equation, an analytical dispersion relation is then obtained with the antenna current set equal to zero. The real and imaginary parts of its roots, which are the complex eigenfrequencies, agree with the central frequencies and widths, respectively, of the numerical antenna-driven resonances. These results serve as an introduction to the companion paper, in which it is shown that, in the presence of a minority species, certain SAE's, instead of heating the plasma exterior, can dissipate substantial energy in the two-ion hybrid layer near the plasma center. 11 refs., 8 figs., 1 tab.

46676 (DOE/ET/51013–271) **Confinement of multiply charged ions in an ECRH mirror plasma.** Petty, C.C. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jun 1989. 170p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/RR–89-9). Order Number DE89016052/JAW. Available from NTIS, PC A08/MF A01 - OSTI; GPO Dep.

This thesis is an experimental study of multiply charged ions in the Constance B mirror experiment. By measuring the ion densities, end loss fluxes and ion temperatures, the parallel confinement times for the first five charge states of oxygen and neon plasmas are determined. The parallel ion confinement times increase with charge state and peak on axis, both indications of an ion-confining potential dip created by the hot electrons. The radial profile of ion end loss is usually hollow due to large ion radial transport ($\tau_{\parallel} \approx \tau_{\perp i}$), with the peak fluxes occurring at the edge of the electron cyclotron resonance zone. Several attempts are made to increase the end loss of selected ion species. Using minority ICRH, the end loss flux of resonant ions increases by 20% in cases when radial transport induced by ICRH is not too severe. A large antenna voltage can also extinguish the plasma. By adding helium to an oxygen plasma, the end loss of O^{6+} increases by 80% due to decreased ion radial transport. An ion model is developed to predict the ion densities, end loss fluxes and confinement times in the plasma center using the ion particle balance equations, the quasineutrality condition and theoretical confinement time formulas. The model generally agrees with the experimental data for oxygen and neon plasmas to within experimental error. Under certain conditions spatial diffusion appears to determine the parallel ion confinement time of the highest charge states. For oxygen plasmas during ICRH, the measured parallel confinement time of the resonant ions is much shorter than their theoretical value, probably due to rf diffusion of the ions into the loss cone. 58 refs., 101 figs., 16 tabs.

46677 (DOE/ET/51013–272) **Simulation and measurement of an electron beam in a wiggler magnetic field.** Smolin, J.A. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jul 1989. 95p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/RR–89-11). Order Number DE89016051/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Sources of high quality beams of spinning electron beams are critical to efficient free electron devices including FELs, CARMs and gyrotrons. Bifilar helical wigglers can take a beam with little perpendicular momentum and add perpendicular momentum, spinning up the beam. The effect of the electron beam self fields on the beam quality will be important. A computer simulation has been written which can simulate the behavior of electron beams in the wiggler region including the effects of the beam self-electric fields. The equations used in the code are described. Several tests of the code are presented. Results of simulation of a bifilar helical wiggler are described. Measurement of beam parameters is also necessary. A design for a capacitive axial velocity probe is presented. The probe has been built but is still untested due to problems with a leaky flange. 15 refs.

46678 (DOE/ET/51013–273) **Massachusetts Institute of Technology Plasma Fusion Center, 1988–1989 report to the President.** Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jul 1989. 26p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/IR–89-1). Order Number DE89016050/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This report discusses the following topics on fusion energy: cold fusion; alcator confinement experiments; applied plasma physics research; fusion systems; coherent electromagnetic wave generation; and fusion technology and engineering. (LSP)

46679 (DOE/ET/53088–374) **Particle simulation in curvilinear coordinate systems.** LeBrun, M.J.; Tajima, T. Texas Univ., Austin, TX (USA). Dept. of Physics. 7 Jun 1989. 76p. Sponsored by DOE/ER;NSF. DOE Contract FG05-80ET53088. ATM-88-11128. (IFSR–374). Order Number DE89016727/JAW. Available from NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.

We present methods for particle simulation of plasmas in a nearly arbitrary coordinate metric and describe a toroidal electrostatic simulation code that evolved from this effort. A Mercier-type coordinate system is used, with a nonuniform radial grid for improved cross-field resolution. A fast iterative method for solving the Poisson equation is employed, and the interpolation/filtering technique shown to be momentum and energy conserving in the continuum limit. Lorentz ion and drift electron species are used. The code has been thoroughly tested for its reproduction of linear and nonlinear physics, and has been applied to the toroidal drift wave problem and its impact on anomalous transport in tokamaks. 40 refs., 10 figs., 1 tab.

46680 (DOE/ET/53088–385) **Theory of high-n toroidicity-induced shear Alfven eigenmode in tokamaks.** Fu, G.Y.; Cheng, C.Z. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Jul 1989. 35p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088;AC02-76CH03073. (IFSR–385). Order Number DE89016726/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

High-n WKB-ballooning mode equation is employed to study toroidicity-induced shear Alfven eigenmodes (TAE) in the $\delta - \alpha$ space, where $\delta = (r/q)(dq/dr)$ is the magnetic shear, and $\alpha = -(2Rq^2/B^2)(dp/dr)$ is the normalized pressure gradient for tokamak plasmas. In the ballooning mode first stability region, TAE modes are found to exist only for α less than some critical value α_c. We also find that these TAE modes reappear in the ballooning mode second stability region for bands of α values. The global envelope structures of these TAE modes are studied by WKB method and are found to be bounded radially if the local mode frequency has a maximum in radius. 15 refs., 14 figs.

46681 (DOE/ET/53088–386) **A study of runaway electron confinement and theory of neoclassical MHD turbulence.** Kwon, Oh Jin. Texas Univ., Austin, TX (USA). Inst. for Fusion Studies. Jul 1989. 150p. Sponsored by U.S. DOE Energy Research. DOE Contract FG05-80ET53088. (IFSR–386). Order Number DE89016728/JAW. Available from NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.

This thesis consists of two major studies: a study of runaway electron confinement and a theory of neoclassical MHD turbulence. The aim of the former is to study the structure of internal magnetic turbulence in tokamaks, which is thought by many to be responsible for the heat transport. The aim of the latter is to extend existing theories of MHD turbulence in tokamaks into experimentally relevant low-collisionality regimes. This section contains a theory of neoclassical pressure-gradient-driven turbulence and a theory of neoclassical resistivity-gradient-driven turbulence.

46682 (IC–88/426) **Nonlinear effects in electron cyclotron plasma heating.** Kotel'nikov, I.A.; Stupakov, G.V. International Centre for Theoretical Physics, Trieste (Italy). Dec 1988. 22p. Order Number DE89635828/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

Nonlinear absorption of an ordinary wave propagating through a plasma perpendicular to unidirectional magnetic field with a frequency close to the electron gyrofrequency is studied. Electron motion is described using a Hamiltonian averaged over rapid gyromotion. The wave evolution in space and time is governed by two equations for the wave amplitude and phase averaged over the wavelength. A case of strong nonlinearity is considered in which the energy absorbed by an electron from the wave is greater than its thermal energy. For this case, the amount of absorbed power is computed analytically assuming it to be small compared with the power of the microwave beam. An effect of nonlinear refraction of the wave is discussed. (author). 17 refs, 4 figs.

46683 (INIS-BR–1597) **Magnetohydrodynamic equilibrium of axisymmetric systems with toroidal rotation.** Mansur, N.L.P. Universidade Estadual de Campinas, SP (Brazil). Inst. de Fisica. 1986. 89p. (In Portuguese). Order Number DE89635829/JAW. Available from NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS.

A model for studying magnetohydrodynamic equilibrium of axisymetrically confined plasma with toroidal rotation, extended to the Grad. Shafranov equation is presented. The expression used for the scalar pressure is modifiec, and the influence of toroidal magnetic field is included, The equation for general motion of axisymetrically confined plasma, particularizing for rotation movements is described. Two cases are compared: one supposes the entropy as a function of poloidal magnetic flux and other supposes the temperature as a function of flux. The equations for these two cases obtaining a simplified expression by others approximations are established. The proposed model is compared with Shibata model, which uses density as function of flux, and with the ideal spheromak model. A set of cases taking in account experimental data is studied. (M.C.K.).

46684 (INIS-SU–72, pp. 65-67) **Plasma production and heating by an ordinary wave in a stellarator in the ECR heating regime.** Andryukhina, Eh.D.; Akulina, D.K.; Batanov, G.M. and others. Gosudarstvennyj Komitet po Ispol'zovaniyu Atomnoj Ehnergii SSSR, Moscow (USSR); Tsentral'nyj Nauchno-Issledovatel'skij Inst. Informatsii i Tekhniko-Ehkonomicheskikh Issledovanij po Atomnoj Nauke i Tekhnike, Moscow (USSR). 1988. (In Russian). In *Thermonuclear synthesis. Scientific-technical collection.* Order Number DE89780074/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Voprosy atomnoj nauki i tekhniki.; no. 2.

Investigation results of currentless plasma production and heating in the L-2 stellator at erc heating by ordinary polyrization wave are presented. The following results are obtained: with $7.1o^{12}$ cm^{-3} mean electron concentration of hydrogen plasma at the heating impulse end the central electron temperature reaches 1 keV, the central ion temperature - 80 eV, plasma energy W $\simeq$200 - 250, power lifetime - 3 ms, ion full power lifetime - 5-6 ms, gasokinetic pressure $\beta \simeq 0.25\%$, heating efficiency - 10-12 ev/(kWx10^{-13} cm^{-3}). Impurities diffusion (D$\simeq 3.10^3$ cm^2/s) is comparable with neoclassical one at erc-heating. 3 refs.; 3 figs.

46685 (INIS-SU–108) **Plasma physics. Collection.** Kratkie Soobshcheniya po fizike. No. 11. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. 62p. (In Russian). Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Individual papers are processed separately.

46686 (INIS-SU–108, pp. 45-47) **Non-equilibrium dynamics of relativistic electron beam in a plasma.** Glazychev, L.V. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Nauryzbaev, A.E.; Sorokin, G.A. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Plasma physics. Collection.* Order Number DE89012206/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 11.

BEAM-PLASMA SYSTEMS/electron beams; BEAM CURRENTS; BETATRON OSCILLATIONS; CURRENT DENSITY; GASES; MAGNETIC FIELDS; MULTIPLE SCATTERING; RELATIVISTIC RANGE; SIMULATION; SPATIAL DISTRIBUTION; TRANSMISSION

46687 (INIS-SU–108, pp. 42-44) **Thermodynamical parameters of weakly nonideal supercooled plasma.** Majorov, S.A. (AN SSSR, Moscow (USSR). Inst. Obshchej Fiziki); Tkachev, A.N.; Yakovlenko, S.I. AN SSSR, Moscow (USSR). Fizicheskij Inst. 1988. (In Russian). In *Plasma physics. Collection.* Order Number DE89012206/JAW. Available from NTIS (US Sales Only), PC A04/MF A01; INIS.

Kratkie Soobshcheniya po Fizike.; no. 11.

Method of multiparticle dynamics is used to analyse dependence of thermodynamical values (density, temperature, ion charge) on time and parameters of completely ionized plasma. It is shown that these values are determined for the period of the order of interparticle distance transit time, and their dependence on plasma parameters is well described by Debye theory. 10 refs.; 2 figs.

46688 (LA-UR–89-2899) **Studies of a strongly coupled plasma produced in a capillary discharge.** Benage, J.F. Jr.; Jones, L.A.; Trainor, R.J. Jr.; Shanahan, W.R.; Shepherd, R.L.; Nothwang, D.P. Los Alamos National Lab., NM (USA). [1989]. 6p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-8908133–1: 24. Yamada conference on strongly coupled plasma physics, 29 Aug - 2 sep 1989). Order Number DE89016611/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

We have carried out an experiment measuring the properties of a strongly coupled ($\Gamma \sim 0.8$) plasma produced in a capillary discharge. Using an analytical model and some 1-D MHD calculations along with the measurements, we were able to determine the density, temperature, strong coupling parameter Γ, and the resistivity of this plasma. We then compared our resistivity measurements to various theories. 5 refs., 5 figs.

46689 (PPPL–2629) **Ignition probabilities for Compact Ignition Tokamak designs.** Stotler, D.P.; Goldston, R.J. Princeton Univ., NJ (USA). Plasma Physics Lab. Sep 1989. 46p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89016932/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

A global power balance code employing Monte Carlo techniques had been developed to study the "probability of ignition" and has been applied to several different configurations of the Compact Ignition Tokamak (CIT). Probability distributions for the critical physics parameters in the code were estimated using existing experimental data. This included a statistical evaluation of the uncertainty in extrapolating the energy confinement time. A substantial probability of ignition is predicted for CIT if peaked density profiles can be achieved or if one of the two higher plasma current configurations is employed. In other cases, values of the energy multiplication factor Q of order 10 are generally obtained. The Ignitor-U and ARIES designs are also examined briefly. Comparisons of our empirically based confinement assumptions with two theory-based transport models yield conflicting results. 41 refs., 11 figs.

46690 (PPPL–2638) **TFTR: Present results and prospects for tritium operation.** Furth, H.P. Princeton Univ., NJ (USA). Plasma Physics Lab. Aug 1989. 36p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. Order Number DE89016021/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Experiments in TFTR are making contributions to several critical problem areas of tokamak reactor design. The magnitude of tokamak plasma transport is found to be sensitive to the shape of the density profile: central peaking may be advantageous for high-temperature tokamak confinement. For moderate-Q reactor operation, the present TFTR data base suffices to solve the three main steady-state reactor-plasma-physics problems of current drive, refueling, and impurity control. The achievement of high Q-values at high fusion power densities is being pursued in the economically promising direction of maximizing performance at moderate plasma current. In TFTR D-T plasmas, fusion reactions due to non-Maxwellian energetic-ion components will serve to generate alpha-particle populations of significant magnitude, permitting the near-term study of collective alpha-particle phenomena. 56 refs., 17 figs., 2 tabs.

46691 **Experimental study of the x-ray transitions in the heliumlike isoelectronic sequence.** Beiersdorfer, P. (Lawrence Livermore National Laboratory, University of California, Livermore, California 94550(US)); Bitter, M.; von Goeler, S.; Hill, K. W. *Physical Review [Section] A: General Physics (USA),* 40(1): 150-157 (1 Jul 1989). DOE Contract AC02-76CH03073.

The wavelengths of the transition $1s2pA^1P_1 \rightarrow 1s^2\ ^1S_0$ in heliumlike potassium, scandium, titanium, vanadium, chromium,and iron have been measuredwith an experimental precision of $\Delta\lambda/\lambda \approx 1/20\,000$.The data typically agree within error bars with recent theoretical predictionsthat include quantum electrodynamical corrections. However, the comparisonshows that there are systematic differences between data and predictions, whichindicate a need to include additional corrections in the calculations. Inparticular, it is found that the experimental wavelengths are consistentlyshorter than the calculated values by amounts which depend on the particulartheoretical prediction used in the comparison. Measurements of the wavelengthsof $\Delta n \geq 2$ x-ray transitions in heliumlike argon, scandium, titanium,vanadium, chromium, and iron are also presented.

46692 **Characterization of deposition and erosion of the TFTR bumper limiter and wall.** Mills, B.E. (Sandia National Labs., Livermore, CA (USA)); Buchenauer, D.A.; Pontau, A.E.; Ulrickson, M. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands),* 162-164: 164 (Apr 1989). (CONF-8805285–: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

To understand material transport by the plasma in the TFTR tokamak, graphite bumper limiter tiles and metal surfaces have been studied. Detailed measurements of the TFTR inner bumper limiter POCO AXF-5Q graphite tiles indicate areas of net erosion and areas of net deposition. These areas are poloidally asymmetric and on the scale of a bay (1/20th of the torus) repeat regularly toroidally. Finer scale measurements indicate that there are subtle variations in the interaction of the plasma with the wall. Furthermore, a study of the correlation of limiter deposits with the type of discharges in TFTR indicates that the material composition depth distribution was determined by the tokamak operational history. In particular, the relative amounts of carbon, hydrogen, oxygen, and metal in the deposits changed over time, reflecting plasma impurity levels. The outer wall of the vessel was not exposed to direct plasma flux and does not show evidence of erosion. (orig.).

46693 **Transport of sputtered impurities in the vicinity of the TFTR inner bumper limiter.** McGrath, R.T. (Sandia National Labs., Albuquerque, NM (USA)); Brooks, J.N. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands),* 162-164: 164 (Apr 1989). DOE Contract AC04-76DP00789. (CONF-8805285–:).

The generation and transport of metallic and carbon impurities on the inner bump limiter of TFTR have been investigated in detail. The spatial profiles for impurity deposition and deposited layer thickness predicted by the analytical model are compared to the extensive postplasma exposure measurements of surface conditions that have been made on the TFTR inner bumper tiles. Agreement between the analytical model and the experimental data is good. The work provides considerable insight into the dynamics of particle transport in the edge region. (orig.).

46694 **Erosion/redeposition modeling and calculations for carbon.** Brooks, J.N. (Argonne National Lab., IL (USA)); Brice, D.K.; McGrath, R.T.; DeWald, A.B. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy*

Industry (Netherlands), 162-164: 164 (Apr 1989). (CONF-8805285--: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

Several key aspects of carbon erosion/redeposition in fusion devices have been examined. These include the effects of an oblique magnetic field geometry plasma sheath on ion impingement and sputtering, and the effect of surface hydrogen buildup on sputtering. The calculations use a version of the MEASTRI hydrogen implantation code and a cloud-in-cell type sheath code. Time dependent erosion calculations have been made for the TFTR bumper limiter, using the REDEP erosion/redeposition code with updated sheath and sputtering models. The computed plasma carbon content during a TFTR limiter "deconditioning" run and for a "supershot" beam heating case is similar to measured values. The calculations predict that depletion of the near surface graphite hydrogen concentration enhances the self and hydrogen sputtering coefficients. This mechanism provides an explanation for the larger Z-effective values observed on TFTR immediately after limiter conditioning. (orig.).

46695 Modeling of spectroscopic measurements of edge recycling. Hogan, J.T. (Oak Ridge National Lab., TN (USA)); Klepper, C.C.; Hillis, D.L.; Uckan, T. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). DOE Contract AC05-84OR21400. (CONF-8805285--:).

The scaling of particle confinement time with density is studied in detail First, we fit the poloidal H_α brightness distributions measured in a density scan series in the TEXT tokamak. Results of the fit suggest that there is not a monotonic decrease of the mean ionization radius with increase in density. While this detailed fitting procedure is an improvement over fitting global H_α data, it still requires the use of free parameters. We show that three-dimensional (3D) Monte Carlo calculations may be used to compute the expected H_α lineshape. As several experiments have recently reported measurement of this quantity, comparison of theoretical and measured values should allow improvement in confinement analysis. We have carried out experiments in the ORNL Plasma Materials Interaction Test Facility to measure the H_α lineshape in discharges with CH_4 injection into pure D_2 plasmas. We have observed the production of H^0 by CH_4 breakup in PMITF, and have measured the lineshape contribution due to dissociation products in a plasma environment. Finally, since many confinement studies are conducted in "carbonized" devices, we have studied the problem of determining the fueling profile in carbon-rich plasmas by calculating the H^0 deposition due to CH_4 breakup. We find that the penetration of H^0 through the scrape-off layer by CH_4 breakup should introduce a significant density scaling in the particle fueling source term. (orig.).

46696 Plasma-edge diagnostics based on Pd-MOS diodes. Bastasz, R. (Sandia National Labs., Livermore, CA (USA)); Cain, B.L.; Ruzic, D.N.; Cayton, T.E.; Hughes, R.C. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). DOE Contract AC04-76DP00789. (CONF-8805285--:).

Pd metal-oxide-semiconductor (MOS) devices can be used to detect energetic hydrogen atoms. H isotopes implanted into a Pd-MOS diode quickly diffuse through the Pd layer and are accommodated at available Pd-SiO_2 interface sites, causing an increase in the leakage current through the device. We find that a diode's response to energetic hydrogen is rapid, sensitive, dosimetric, and reproducible. Pd-MOS diodes can be regenerated when saturated with hydrogen by heating to 100-200^{0}C for a few minutes. These properties make Pd-MOS diodes useful for plasma-edge diagnosis of hydrogen particle fluence when the energy distribution of the incident hydrogen is known. Pd-MOS diode sensors have been used in the laboratory and in the ZT-40M reversed-field pinch to measure energetic hydrogen fluxes. Their small size allows placement in locations inaccessible to conventional diagnostics and should provide a means for remote monitoring of hydrogen fluxes to plasma-facing surfaces. (orig.).

46697 Modeling of neutral transport and impurity generation in the Tore Supra pump limiter. Klepper, C.C. (Oak Ridge National Lab., TN (USA)); Owen, L.W.; Mioduszewski, P.K.; Grosman, A. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). DOE Contract AC05-84OR21400. (CONF-8805285--:).

A system of modular pump limiters is employed in Tore Supra for particle control. It includes one large outboard module which is instrumented with an optical multi-channel analyzer viewing the neutralizer plate, in addition to pressure, temperature and particle diagnostics. The transport of neutrals in both the particle scoop mode and in the pump limiter mode with active pumping is modeled with the DEGAS code. Equilibrium neutral pressure and density, H_α-intensity at the neutralizer plate, and particle back-flow into the scrape-off layer are calculated for typical projected plasma edge conditions. Effects on neutral particle transport of varying the length of the "shelf" separating the throat region from the pumping chamber are investigated. The generation and transport of carbon impurities arising from ion impact sputtering at the neutralizer plate are estimated. The short mean-free-path for ionization of sputtered carbon atoms suggests the possibility of spectroscopically measuring the effects of poloidal flux variations arising from shadowing of the modular limiter system. (orig.).

46698 Experimental investigation of the natural divertor configuration in Heliotron-E. Hillis, D.L. (Oak Ridge National Lab., TN (USA)); Mioduszewski, P.K.; Fowler, R.H.; Rome, J.A.; Motojima, O.; Mizuuchi, T.; Noda, N.; Mutoh, T.; Zushi, H.; Takahashi, R. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). DOE Contract AC05-84OR21400. (CONF-8805285--:).

Particle control with pump limiters and divertors has been successfully demonstrated in a number of present-day tokamaks. In a heliotron/stellarator configuration, plasma flows to the wall in distinct flux bundles, often called "divertor stripes". This complicated three-dimensional characteristic of the plasma edge presents a new challenge for active particle control systems such as pump limiters and divertors. The experiment described here has obtained data with an instrumented pumped particle collector that is located in the "natural" magnetic divertor stripe of Heliotron-E. The particle collector consists of a moveable graphite assembly with single-sided particle collection and active pumping. By scanning the particle collector assembly through the plasma edge of Heliotron-E, the divertor stripe is observed to be about 2-3 cm (fwhm) in width, and pressure rises of 0.1-0.2 mTorr are observed in the particle collector pumping chamber. These measurements have demonstrated that particles leaving the bulk plasma via the divertor stripes can be collected and provide a basis for developing a divertor scheme for particle control in helical systems. Modeling of the Heliotron-E magnetic configuration at the plasma edge is used to determine the collection efficiency of the particle collector in the divertor stripes. The modelling is further extended to describe a helical divertor concept. (orig.).

46699 The interaction of tritium with graphite and its impact on tokamak operations. Causey, R.A. (Sandia National Labs., Livermore, CA (USA)). *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). (CONF-8805285--: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

The state of knowledge of tritium retention in graphite and how it affects the operation of tokamak fusion reactors is reviewed. The retention of tritium in the saturated surface layer exposed to the plasma, retention in the surface connected porosity, retention in the graphite grains, and retention in the co-deposited carbon/tritium layer are discussed along with an assessment of the relative importance of each component for fusion reactors. Data on the diffusivity and solubility of tritium in graphite are analyzed to pick the "best estimate" for both of these parameters. Tritium trapping in graphite is considered along with an explanation for its cause and an estimate of its magnitude. (orig.).

46700 Characterization of sub-10-μm 30-ps flash duration point sources for x radiography. Failor, B. H. (KMS Fusion, Inc., Ann Arbor, Michigan 48106(US)); Gabl, E. F.; Johnson, R. R.; Shepard, C. *Journal of Applied Physics (USA)*, 66(4): 1571-1578 (15 Aug 1989). DOE Contract AC03-87DP10560.

Flash x radiography can provide important information about high-density, high-opacity plasmas. Experiments at KMS investigated the

characteristics of point x-ray sources produced when coated fibers, wires, and mounted particles were irradiated with high intensity ($I > 10^{16}$ W/cm^2) green laser light. The target materials Bi, CsI, Au, and Ag were evaluated in the areas of (1) the spatial and temporal resolutions that can be achieved, (2) the effect of source size and laser pulse duration on x-ray signal strength, and (3) the practical considerations associated with using the technique to actually obtain radiographs of accelerated polyvinyl alcohol shells.

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Refer also to citation(s) 45483, 45898, 46553, 46699

46701 (AD-A–208129/7/XAB) **Experimental and numerical studies of laser-sustained gas plasmas. Final report, 1 February 1988-15 March 1989.** Mazumder, J.; Krier, H.; Mertogul, A.; Schwartz, S.; Chen, X. Illinois Univ., Urbana, IL (USA). Dept. of Mechanical and Industrial Engineering. Apr 1989. 88p. (UILU-ENG–89-4005). Available from NTIS, PC A05/MF A01.

Laser propulsion is the production of high-specific-impulse rocket thrust using a high-power laser as a remote energy source. Specific impulses in excess of 1000 seconds are achievable because propellant temperatures are very high and low-molecular-weight gases can be used. This report focuses on the energy-conversion mechanisms of laser-sustained plasmas in pure flowing argon and argon/helium mixtures. Experiments at very high argon mass flux (55 kg/m2s) and pressure as high as 2.5 atmospheres were performed. The results indicate that nearly all the laser power can be absorbed (>97%), and efficiencies approaching 50% can be obtained. Experiments with mixtures of argon and helium indicate that the high specific heat and thermal conductivity of the helium tends to allow for more of the absorbed energy to be retained rather than reradiated to the chamber walls. This despite the fact that the very high ionization energy of helium limits the global absorption to values below that for pure argon plasmas. Fundamental research concerning laser-sustained plasmas such as the independent experimental determinations of electron number density and electron temperature is required. This will allow the evaluation of the local thermal equilibrium which is needed in order to better interpret the spectroscopic and numerical results. Also required is the more accurate determination of downstream plasma exhaust gas temperature via Rayleigh scattering thermometry. This technique is impervious to plasma and laser irradiation interferences and to gas heat loss to the chamber walls, thus thermal-efficiency calculations will be much more accurate than in the past.

46702 (CONF-890850–1) **Propagation of normal zones of finite size in large, composite superconductors.** Dresner, L. Oak Ridge National Lab., TN (USA). [1989]. 14p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From 11. international conference on magnet technology; 28 Aug - 1 sep 1989. Order Number DE89016866/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Very large, composite superconductors have been proposed for use in energy storage magnets. A typical conductor, rated at 230 kA, has been discussed by J. Waynert, Y. Eyssa, and X. Huang, namely, a 6-cm aluminum cylinder with superconducting filaments on its outer surface. Owing to its large size and nonuniform distribution of filaments, such a conductor can sustain normal zones of finite size that travel at a uniform velocity along the conductor. This paper presents a simple, analytical model that permits determination of the conditions under which such zones can exist and the size and velocity of such zones. It has been shown that the transport current has a threshold value below which finite normal zones cannot exist and that the propagation velocity corresponding to this threshold current, though not zero, is the smallest possible. 1 ref., 3 figs.

46703 (DOE/ET/51013–T214) **Upgrade of a fusion accident analysis code and its application to a comparative study of seven fusion reactor designs.** Porter, L.J. Massachusetts Inst. of Tech., Cambridge, MA (USA). Plasma Fusion Center. Jun 1989. 112p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-78ET51013. (PFC/RR–89-10). Order Number DE89016059/JAW. Available from NTIS, PC A06/MF A01 - OSTI.

Fusion energy has the potential to be a safe and environmentally favorable energy source. The importance of safety necessitates the existence of a computer code having the capability of assessing offsite impacts resulting from postulated fusion reactor accidents. The FUSCRAC3 computer code has been developed for this purpose. FUSCRAC3 calculates doses resulting from inhalation, groundshine, and cloudshine for 259 isotopes as well as doses resulting from ingestion for 145 isotopes. FUSCRAC3's data base includes the most up-to-date dose conversion factors for all four exposure pathways as well as the most current environmental transfer factors for the ingestion pathway. This work presents a detailed description of the modifications made to the existing fusion reactor accident code, FUSCRAC2, in the development of the more advanced FUSCRAC3 computer code. Also included is a report of the validation procedures. Finally, the improved computer code was applied in two ways: to provide a general data base presenting rem per curie data for each isotope and to assess the doses resulting from possible releases from the reactors evaluated in the ESECOM study. Regarding the latter application, it was found that the general trends established in the original study remained unchanged. However, it was determined that the inclusion of the ingestion pathway substantially affects the overall chronic dose. Isotopes of particular interest due to the ingestion contribution include H-3, Ca-45, Fe-55, and Po-210. 12 refs., 2 figs., 12 tabs.

46704 (EUR–11705, pp. 157-164) **Considerations on ECFH current drive and bootstrap current for W VII-X.** Gasparino, U. (Max-Planck-Institut fuer Plasmaphysik, Garching-Muenchen (DE)); Maassberg, H. Commission of the European Communities, Luxembourg (Luxembourg). 1988. (CONF-8806386–: 2. workshop on Wendelstein VII-X, 13-16 Jun 1988). In *Proceedings of the 2. Workshop on Wendelstein VII-X.* Order Number DE89634438/JAW. Available from NTIS (US Sales Only), PC A24/MF A01.

Low shear is the characteristic of all proposed Wendelstein VII-X configurations. To avoid low harmonic rational numbers within the rotational transform profile, the current contribution to the rotational transform, $\Delta\iota_s \alpha\ I/B$, should be typically less than 10%. This leads to an upper limit of 50 kA (at B = 2.5 T) for the tolerable net toroidal current. A considerable net toroidal current (bootstrap current) is expected by neoclassical theory in the plateau and the low-collisionality regimes. Both radial transport as well as the bootstrap current densities depend sensitively on the magnetic configuration (see A. Montvai, this workshop). In case of an axisymmetric configuration with dimension and plasma parameters as predicted for the high-$< \beta >$ regime of WVII-X ($< \beta > \sim$ 5%), this current ($\sim$ 0.5/1 MA) would dominate the rotational transform profile. This requires a reduction of magnitude of the bootstrap current to some % of the value of an equivalent tokamak. This reduction must act on the current profile itself and should not be merely obtained by having two channels of currents of different sign at different radii. Due to the possibility of controlling absorbed power and driven current profiles, electron cyclotron waves are a natural candidate for current profile control. Linear calculations show the possibility to drive a counteracting current with a profile similar to the bootstrap one. For $< \beta >$ $\sim$ 5% conditions, however, the optimium current drive efficiency (eta $\sim$ 10 kA per MW) is far too low to make ECF-current drive suitable.

46705 (IAEA-TECDOC–495, pp. 35-49) **Maintenance of JT-60.** Shimizu, M. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Energy Research Establishment). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The objectives of JT-60 are to achieve and investigate hydrogen plasmas with equivalent Q=1 conditions and to make an integrated test of fusion technologies required for the next stage of advancement. JT-60 is composed of numerous components of the tokamak machine, the vacuum pumping system, the power supply system, the heating system, and the control system etc. JT-60 has been successfully in operation since April '85. It is owing to deliberate design, careful fabrication and maintenance and speedy trouble

shooting. For instance, the bolted first wall is easily changeable and monitored during operation period in vacuum by the in-vessel inspection system, so as to shorten the period of shut down. Several kinds of criteria are settled for electrical insulation and vacuum control etc., and strictly applied for actual operation and maintenance. (author). 13 refs, 13 figs, 3 tabs.

46706 (IAEA-TECDOC–495, pp. 51-62) **Maintenance approach and remote equipment design for FER.** Tachikawa, K. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Energy Research Establishment); Adachi, J.; Iida, H.; Kobayashi, T.; Miki, N.; Saito, R.; Yamada, M. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The latest FER remote maintenance concept and various remote equipments design are described. Reactor concept of the FER is decided based primarily on tradeoffs between reliability of maintenance scheme and minimization of capital costs. Key features of the FER structure are: (1) the most reliable maintenance procedure, (2) optimization of PF coil allocation, (3) installation of sacrificed "guard limiter" on the inboard first wall area against off-normal conditions, and (4) reliable and simple shielding structure (water-tank type shield). Local guard limiters are designed to be easily replaceable without breaking a plasma vacuum. Outboard shield and divertor modules are planned to be removed by horizontal access with reliable single straight-line motion. Transfer casks are prepared for the containment of tritium and activated debris during transportation. As for equipments, design study puts emphasis upon the "inboard/outboard limiter handling equipments", "transfer cask for tritium/radioactive debris", and "in-vessel manipulator system for inspection". This paper consists of general description of the FER, design philosophy, design conditions, maintenance procedure, remote handling equipments, repair facility, and urgent R and D issues/JAERI's R and D programme for remote handling. (author). 7 refs., 6 figs., 3 tabs.

46707 (IAEA-TECDOC–495, pp. 75-87) **Maintenance concepts for NET.** Holloway, C. (Max-Planck-Institut fuer Plasmaphysik, Garching (Germany, F.R.)); Salpietro, E. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Remote maintenance of NET in-vessel and ex-vessel components is described together with concepts for the maintenance equipment. The application of robotic devices and tele-manipulators to the servicing of fusion machines is discussed. It is concluded that, except for certain well defined situations, the unpredictable nature of the maintenance requirements are best suited by the flexibility of the tele-manipulator. (author). 7 refs, 6 figs.

46708 (IAEA-TECDOC–495, pp. 91-94) **Remote maintenance concepts for nuclear plants.** Boehme, G. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The importance of remote maintenance in nuclear plants is increasing. Remote replacement of components to be maintained is preferred to in-place repair. Overhead bridge cranes in combination with an impact wrench are used as remote tools for the operation of specially developed remote connectors. Other concepts prefer the use of manipulators and commercially available connectors. The replaced components can be maintained or dismantled by electrical master slave manipulators and adapted tools. Remote maintenance of the maintenance equipment itself has to be provided and sometimes redundant systems are required for the case of failures or accidents. (author). 6 refs.

46709 (IAEA-TECDOC–495, pp. 63-74) **JET remote maintenance system.** Raimondi, T. (Commission of the European Communities, Abingdon (UK). JET Joint Undertaking). International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

One of the main objectives of JET is to reach near ignition conditions in D-T phase during an operational period of two years, when remote maintenance will be needed due to neutron activation. The maintenance criterion has been to replace rather than repair faulty components. The machine is segmented so that in case of major failure an octant can be replaced. To achieve a high degree of reliability, established technology has been applied throughout and in particular to vaccum, fluid and electrical connections, which are defined and standardised in the remote handling manual. To cope with the complexity and unpredictability of the tasks likely to be required, a flexible system, consisting of general purpose handling devices positioned by large transporters and supplemented by special tools, has been adopted. For remote operations within the vacuum vessel the transporter is an articulated boom which can reach all around the torus through a horizontal port. It carries either a manipulator or end-effectors for handling heavy components. Outside the vessel a crane-mounted telescopic mast will position a manipulator all around the machine, working in combination with lifting facilities provided by the main hook of the crane or by an auxiliary jib crane mounted on the telescopic mast, and in areas not accessible from above, by a low-level transporter. Periodic inspections of the interior of the vessel have to be done to check for damage due to plasma disruptions. Our system scans the vessel under vacuum using four TV probes through small apertures in the top of the vessel and can work at operating temperature (300 deg. C). Remote handling specialists vet the design of all systems classified as requiring remote handling, and prepare procedures for the envisaged maintenance. Mock-up tests lead to the identification of special tools and computer-aided techniques which may be needed.

46710 (IAEA-TECDOC–495, pp. 141-149) **Investigations of in-vessel handling concepts for NET.** Suppan, A. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Hauptabteilung Ingenieurtechnik); Huebener, J. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

Up to a weight of 1 ton NET in-vessel components will be handled by means of handling units which enter the torus through four horizontally arranged ports. The in-vessel handling unit (IVHU) consists of a radially movable carrier, an articulated boom extendable to about 25 m and suitable to reach any point of the torus. Three work units are optionally attachable to the end-frame of the boom. Components and equipment will be transferred by a carrier with telescopic arm. Plug handling devices are foreseen to open and close the entry ports. The equipment is housed in contained transfer units permanently attached to the ports and transferable via transport flasks to a service area. IVHU-carrier and articulated boom are connected by a combined yaw and roll joint. The 11 links of the boom are modular designed. Each of their yaw links is moved by two motor driven planetary roller spindles which actuate in series. The drives are externally arranged at the upper side of the links. Supply lines are routed inside the link boxes. A combined pitch and roll joint allows the end-frame adjustment. Three types of work units were investigated. An electrical master slave manipulator

unit and two devices for the replacement of radiofrequency antennae and divertor plates. The IVHU can be controlled manually and automatically. Designing an experimental device for in-torus handling with an IVHU as a principal item has been launched. (author). 4 refs, 7 figs, 1 tab.

46711 (IAEA-TECDOC–495, pp. 189-197) **Development of elemental techniques for in-vacuum remote manipulators of fusion devices.** Obara, K. (Japan Atomic Energy Research Inst., Naka, Ibaraki (Japan). Naka Fusion Energy Research Establishment); Murakami, Y. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

A number of works have been done at JAERI to develop elemental techniques for in-vacuum manipulators through the process of fabrication and performance test of an in-situ coating machine, a leak hunting device and a multi-joint remote handling machine. Major technical problems encountered in the course of the development are the selection of driving methods, improvement of lubricating materials and mitigation of outgassing from constructional materials. The purpose of the in-situ coating machine is to inspect and repair the eroded or damaged surface of TiC-coated tiles in the JT-60 vacuum vessel. The machine basically consists of an in-vacuum manipulator with a long arm of four degrees of freedom, a quartz fiberscope and ohmically heated titanium evaporators. The leak hunting device is composed of a light-weighted manipulator and a small ionization gauge attached to the tip of the manipulator arm. Leak points can be located by moving the ionization gauge along the inner wall of the test vessel. In the above two applications, MoS_2-coated Inconel (or stainless steel) is used for most movable parts including gears, Ag-ionplated stainless steel for ball bearings, and a self-lubricating alloy for slide bearings. A preliminary test was also made of an in-vacuum remote handling machine with multi-joint arms. In this case, each joint has its own driving unit consisting of electric motor, torque sensor, electronic circuit for control, gears, bearings, etc., and is exposed to a high vacuum. A special hydrocarbon grease is used as the lubricant since no solid lubricating materials endure the strong forces fallen on the gears of the joint. (author). 7 refs, 8 figs, 1 tab.

46712 (IAEA-TECDOC–495, pp. 249-260) **Towards more automation for remote maintenance.** Benner, J. (Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Inst. fuer Reaktorentwicklung); Fischer, C.; Leinemann, K.; Stratmanns, E.; Till, W. International Atomic Energy Agency, Vienna (Austria). Feb 1989. (CONF-8802131–: International meeting on robotics and remote maintenance concepts for fusion machines, 22-24 Feb 1988). In *Robotics and remote maintenance concepts for fusion machines. Proceedings of a technical committee meeting held in Karlsruhe, 22-24 February 1988.* Order Number DE89634440/JAW. Available from NTIS (US Sales Only), PC A15/MF A01 - OSTI; INIS.

The CATROB telerobotic system as a kinematical prototype for remote handling in hazardous environments like a fusion reactor is described. It consists of an industrial robot, mounted on a gantry crane with two degrees of freedom. The basic functional principle of this system is the synthesis of sensory-guided automatic and operator-controlled manual operation in order to minimize the time needed for performing remote maintenance and inspection. The goal is to automize all preplannable operations and to support the operator in performing manual remote handling by a graphics based simulation system. In the present state, automatically bolting and unbolting of flanges and handling of plug connections is realized with CATROB. In the paper the software and hardware architecture of the system and its sensory equipment are described, and some preliminary results on the system performance are reported. (author). 12 refs, 10 figs.

46713 (INIS-BR–1623) **Heat transfer phenomena in the first wall of the RFX fusion experiment.** Oliveira Pauletti, R.M. de. Associacao Brasileira de Ciencias Mecanicas, Rio de Janeiro, RJ (Brazil). Dec 1988. 4p. (CONF-8812106–: 2. National Meeting of Thermal Science, 6-8 Dec 1988). Order Number DE89635841/JAW. Available from NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS.

The thermal analysis of the first wall (FW) of the RFX machine is presented. RFX is a large fusion experiment under construction at Padua, Italy. The RFX FW is briefly described, together with the critical thermal conditions. The numerical analyses performed to predict the FW thermal behaviour are presented. 1-D and 2-D finite element models give accurate predictions of the FW temperatures and of the thermal exchanges in the machine environment. (author).

46714 (IPPJ-T–37) **Proceedings of the Japan-U.S. workshop P-119 on 14 MeV neutron source for material R and D based on plasma devices.** Miyahara, A.; Coensgen, F.H. (eds.). Nagoya Univ. (Japan). Inst. of Plasma Physics. Jun 1988. 412p. (CONF-8806400–: Japan-U.S. workshop P-119 on 14 MeV neutron source for material R and D based on plasma devices, 7-10 Jun 1988). Order Number DE89906613/JAW. Available from NTIS (US Sales Only), PC A18/MF A01.

In addition to the development of an adequate means to contain reacting D-T plasma in the range of 100 million deg K, the successful development of nuclear fusion as an energy source requires the development of new long-lived, low-activation materials. These new fusion reactor materials should not become radioactive when subjected to intense neutron irradiation for a long period. If the induced radioactivity cannot be entirely avoided, it must be short-lived and at relatively low level. The material development is already in progress using existing fission irradiation facilities and low level 14 MeV neutron sources. But the final selection and qualification of fusion reactor materials will require end of life testing. The neutron irradiation facilities for this purpose, the approximation of D-T neutron spectrum and the design of fusion material irradiation test (FMIT) are discussed. The workshop P-119 was organized to promote the development of plasma-based neutron sources. The presentation of each concept included its physics basis, neutron field characteristics, the required research and development and their schedules, and the rough estimation of the costs for development, construction and operation. (K.I.).

46715 (KFK–4588) **Nuclear Fusion Project. Semi-annual report of the Association KfK/EURATOM. October 1988 - March 1989.** Kast, G. Kernforschungszentrum Karlsruhe G.m.b.H. (Germany, F.R.). Projekt Kernfusion. Apr 1989. 81p. Order Number DE89915168/JAW. Available from NTIS (US Sales Only), PC A05/MF A01.

Report on technology tasks: Blanket design studies; development of computational tools for neutronics; corrosion and fatigue of structural materials in flowing Pb-17Li; tritium extraction from liquid Pb-17Li by the use of solid getters; ceramic breeder materials; high field composite conductors; superconducting poloidal field coil development; design and construction of a poloidal field coil for TORE SUPRA as NET-prototype coil; structural materials fatigue characterization at 4 K; low electrical conductivity structural development; MANET 1; pre- and post-irradiation fatigue properties of 1.4914 martensitic steel; in-pile creep-fatigue testing of type 316 and 1.4914 steel; ceramics for first-wall protection and for RF windows; fatigue under dual beam irradiation; low activation ferritic-martensitic steels; plasma facing components; procedures and tools for structural design evaluation; remote maintenance; mechanical component assembly; handling equipment for in-vessel components; safety aspects of the cryosystem and of superconducting magnets; safety guidelines for the design of NET; generic environmental impact assessment for a fusion facility; large components for plasma exhaust pumping; optimization of cryogenic vacuum pumping of He; solid particle separators for plasma exhaust; plasma exhaust purification; adsorption of DT on heated metal beds other than U; catalyst development for the exhaust purification process; ECRH power sources; vacuum and exhaust performance of NET; NET TF pancake tests; CAD DATA exchange between NET and KfK; catalytic plasma exhaust gas clean-up facility for NET; NET blanket handling device; electrical connectors for remote handling. (orig./HP).

46716 (LA-UR–89-2489) **The reversed-field-pinch (RFP) fusion neutron source: A conceptual design.** Bathke, C.G.; Krakowski, R.A.; Miller, R.L.; Werley, K.A. Los Alamos National Lab., NM (USA). 1989. 25p. Sponsored by U.S. DOE Energy

Research. DOE Contract W-7405-ENG-36. (CONF-8902118–2: International Energy Agency workshop on fusion materials irradiation facilities, 14-17 Feb 1989). Order Number DE89015297/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The conceptual design of an ohmically heated, reversed-field pinch (RFP) operating at ~5-MW/m^2 steady-state DT fusion neutron wall loading and ~124-MW total fusion power is presented. These results are useful in projecting the development of a cost effective, low input power (~206 MW) source of DT neutrons for large-volume (~10 m^3), high-fluence (3.4 MW yr/m^2) fusion nuclear materials and technology testing. 19 refs., 15 figs., 9 tabs.

46717 (LA-UR–89-2782) **ANTHEM simulation of the early time magnetic field penetration of the plasma surrounding a high density Z-pinch.** Mason, R.J. Los Alamos National Lab., NM (USA). 1989. 7p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-36. (CONF-8904107–8: 2. international conference on high-density pinches (ICHDP-2), 26-28 Apr 1989). Order Number DE89016980/JAW. Available from NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.

The early time penetration of magnetic field into the low density coronal plasma of a Z-pinch fiber is studied with the implicit plasma simulation code ANTHEM. Calculations show the emission of electrons from the cathode, pinching of the electron flow, magnetic insulation of the electrons near the anode, and low density ion blow off. PIC-particle ion calculations show a late time clumping of the ion density not seen with a fluid ion treatment. 4 refs., 4 figs.

46718 (N–89-23300) **Development and simulation study of a new inverse-pinch high Coulomb transfer switch. Final report.** Choi, S.H. Information and Control Systems, Inc., Hampton, VA (USA). May 1989. 42p. (NASA-CR–181768;FR–688102;NAS–1.26:181768). Available from NTIS, PC A03/MF A01.

The inverse-pinch plasma switch was studied using a computer simulation code. The code was based on a 2-D, 2-temperature magnetohydrodynamic (MHD) model. The application of this code was limited to the disk-type inverse-pinch plasma switch. The results of the computer analysis appear to be in agreement with the experimental results when the same parameters are used. An inverse-pinch plasma switch for closing has been designed and tested for high-power switching requirements. An azimuthally uniform initiation of breakdown is a key factor in achieving an inverse-pinch current path in the switch. Thus, various types of triggers, such as trigger pins, wire-brush, ring trigger, and hypocycloidal-pinch (HCP) devices have been tested for uniform breakdown. Recently, triggering was achieved by injection of a plasma-ring (plasma puff) that is produced separately with hypocycloidal-pinch electrodes placed under the cathode of the main gap. The current paths at switch closing, initiated by the injection of a plasma-ring from the HCP trigger are azimuthally uniform, and the local current density is significantly reduced, so that damage to the electrodes and the insulator surfaces is minimized. The test results indicate that electron bombardment on the electrodes and the insulator surfaces is minimized. The test results indicate that electron bombardment on the electrodes is four orders of magnitude less than that of a spark-gap switch for the same switching power. Indeed, a few thousand shots with peak current exceeding a mega-ampere and with hold-off voltage up to 20 kV have been conducted without showing measurable damage to the electrodes and insulators.

46719 (ORNL/FTR–2820) **[US/Japan collaborative program using the High Flux Isotope Reactor (HFIR) for irradiation of fusion reactor structural materials]: Foreign trip report, February 14, 1988–February 20, 1988.** Bloom, E.E. Oak Ridge National Lab., TN (USA). 7 Mar 1988. 7p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017301/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Discussions were held with JAERI staff, led by Dr. T. Kondo, for the purpose of reviewing progress on the US/Japan Collaborative Fusion Materials Program using the HFIR, to update our Japanese partners on the status of HFIR, and to develop a scenario for continuation of the collaboration on HFIR restart. Important results on the effect of He/dpa ratio on irradiation-induced swelling and creep recently obtained from the ORR/HFIR spectral tailoring experiments were reviewed. These results reinforce the need for continuation of the program planned for the HFIR RB facility. The Japanese are clearly concerned about the continuing shutdown of HFIR. The US/Japan collaborative program is a key part of their total program to develop and qualify a material for use in the Japanese Fusion Experimental Reactor (FER). Because no plan or schedule for restart of HFIR has been agreed upon by ORNL and DOE, it was arbitrarily decided to develop a scenario for the second five years of the collaborative program based upon the assumption that HFIR will restart on October 1, 1988.

46720 (ORNL/FTR–2839) **Workshop on the effects of recoil spectrum and nuclear transmutations on the evolution of the microstructure: Foreign trip report, March 22, 1988–March 28, 1988.** Pedraza, D.F. Oak Ridge National Lab., TN (USA). 13 Apr 1988. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. Order Number DE89017284/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The workshop opened with three nonscientific presentations. First, the activities of the recently created Paul Scherrer Institute were described. Next followed a short welcome by the EURATOM representative. Third, the present status of the NET (the Next European Torus) Materials Program was described by Dr. Nihoul, of the NET-Team. The scientific program that followed can be subdivided into two groups which covered the two subjects of the workshop, namely, those related to the displacement cascade effects, and those related to nuclear transmutations, mainly helium. The quality of the presentations was generally high, representing especially the ongoing efforts in the scientific community to achieve an advanced understanding of the geometry and dynamics of displacement cascades both theoretically and experimentally. This subject is not only of interest to the fusion energy programs but to the entire radiation effects community. The importance of this field of research is focused in the formulation of valid fission-fusion correlations concerning microstructural evolutions that spectra. It was argued that an assessment of the effects of helium when establishing these correlations is vital.

46721 (PNL-SA–16438) **Radioactive waste disposal for fission and fusion reactors.** Heinisch, H.L.; Doran, D.G. Pacific Northwest Lab., Richland, WA (USA). [1989]. 5p. Sponsored by U.S. DOE Energy Research. DOE Contract AC06-76RL01830. Order Number DE89016047/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The calculated radioactive waste inventories of the Turkey Point pressurized water fission reactor (PWR) and the Starfire conceptual fusion tokamak are compared as a function of time from initial start-up to 10,000 years after decommissioning. Only material out of reactor at least one year is considered. The total activity in Ci/W(th) of the Starfire tokamak is slightly greater than that of the PWR during the active lifetimes of the two reactors and beyond 1000 years. However, using reduced activation materials in Starfire can result in about 1/2000 as much long-lived radioactivity as in the fission reactor. It is stressed that comparison of wastes on this basis is not straightforward, since the radioisotopes and methods required for their disposal are different for fusion and fission reactors. 2 refs., 1 fig., 2 tabs.

46722 (PPPL–2642) **A comparison of hydrogen vs. helium glow discharge effects on fusion device first-wall conditioning.** Dylla, H.F. Princeton Univ., NJ (USA). Plasma Physics Lab. Sep 1989. 16p. Sponsored by U.S. DOE Energy Research. DOE Contract AC02-76CH03073. (CONF-8904230–4: AVS topical conference on surface conditioning of vacuum systems, 3-7 Apr 1989). Order Number DE89016954/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

Hydrogen- and deuterium-fueled glow discharges are used for the initial conditioning of magnetic fusion device vacuum vessels following evacuation from atmospheric pressure. Hydrogenic glow discharge conditioning (GDC) significantly reduces the near-surface concentration of simple adsorbates, such as H_2O, CO, and CH_4, and lowers ion-induced desorption coefficients by typically three orders of magnitude. The time evolution of the residual gas production observed during hydrogen-glow discharge conditioning of the carbon first-wall structure of the TFTR device is similar to the time evolution observed during hydrogen GDC of the initial first-wall configuration

in TFTR, which was primarily stainless steel. Recently, helium GDC has been investigated for several wall-conditioning tasks on a number of tokamaks including TFTR. Helium GDC shows negligible impurity removal with stainless steel walls. For impurity conditioning with carbon walls, helium GDC shows significant desorption of H_2O, CO, and CO_2; however, the total desorption yield is limited to the monolayer range. In addition, helium GDC can be used to displace hydrogen isotopes from the near-surface region of carbon first-walls in order to lower hydrogenic retention and recycling. 38 refs., 6 figs.

46723 (SAND–89-0901) **Design considerations for ITER [International Thermonuclear Experimental Reactor] plasma facing components.** McGrath, R.T.; Koski, J.A.; Watson, R.D.; Causey, R.A.; Croessmann, C.D.; Dempsey, J.F.; Hosking, M.; Neimer, K.A.; Russo, A.J.; Salmonson, J.C.; Stephens, J.; Smith, M.F.; Watkins, J.G.; Whitley, J.B. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 110p. Sponsored by U.S. DOE Energy Research. DOE Contract AC04-76DP00789. Order Number DE89015200/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The International Thermonuclear Experimental Reactor (ITER) is a joint design and R&D project involving the USA, the Soviet Union, Japan and the European Community. These international partners are working together on the design of a fusion tokamak reactor that will operate in the D-T ignition regime. This report compiles the contributions to ITER made by Sandia National Laboratories in the area of design and R&D for plasma facing components, such as the first wall and divertor. The following topics are discussed: divertor fabrication issues, divertor thermal-hydraulic analysis, separatrix sweeping effects, divertor tile 2-D stress analysis, electromechanical disruption effects, runaway electron and intense energy deposition analyses, lifetime analysis and tritium retention in plasma facing materials. Material properties for pyrolytic graphite and beryllium are presented. Use of pyrolytic graphite as the plasma facing material allows for operation with thicker graphite armor at the design heat flux level of 10 MW/m^2. The design of a divertor coated with plasma sprayed beryllium is presented as an attractive alternative to pyrolytic graphite armor tiles. Finally, the Sandia research and development plan for ITER is discussed. 82 figs.

46724 (UCLA/PPG–1247) **PISCES program plasma-surface interactions research: Summary of research, 1988–1989.** California Univ., Los Angeles, CA (USA). Inst. for Plasma and Fusion Research. May 1989. 51p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-86ER52134. Order Number DE89015622/JAW. Available from NTIS, PC A04/MF A01 - OSTI; GPO Dep.

This paper discusses the following about the Pisces program: Major objectives of the program; Staff in the PISCES program at UCLA; Highlights in the program; Collaborations with other institutions; PISCES-A facility; PISCES-B facility; Fast scanning Langmuir probe; Omegatron mass spectrometer; Spectroscopic diagnostics; Data acquisition system; Redeposition effect on carbon chemical erosion; Erosion of carbon tokamakium from TFTR; Effect of boron-doping on carbon chemical erosion; Radiation enhanced sublimation of carbon; Surface analysis of TEXTOR titles; Spectroscopic analysis of carbon impurities; Biased limiter and divertor; Biased divertor channel; Gaseous divertor experiments; Presheath profile measurements; Particle transport in CCT tokamak; and Biased divertor experiments in CCT.

46725 (UCRL–100798) **Low-density carbonized composite foams for direct-drive laser ICF targets.** Kong, Fung-Ming. Lawrence Livermore National Lab., CA (USA). Mar 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890902–6: 198. American Chemical Society national meeting, 10-15 Sep 1989). Order Number DE89012328/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The design for a direct-drive, high-gain laser inertial confinement fusion target calls for the use of a low-density, low-atomic-number foam to confine and stabilize liquid deuterium-tritium (DT) in a spherical-shell configuration. Over the past two years, we have successfully developed polystyrene foams (PS) and carbonized resorcinol-formaldehyde foams (CRF) for that purpose. Both candidates are promising materials with unique characteristics. PS has superior mechanical strength and machinability, but its relatively large thermal contraction is a significant disadvantage. CRF has outstanding wettability and dimensional stability in liquid DT; yet it is much more fragile than PS. To combine the strengths of both materials, we have recently developed a polymer composite foam which exceeds PS in mechanical strength, but retains the wettability and dimension stability of CRF. This paper will discuss the preparation, structure, and properties of the polymer composite foams. 5 refs., 1 fig., 1 tab.

46726 Collector probe measurements of ohmic conditioning discharges in TFTR. Kilpatrick, S.J. (Princeton Univ., NJ (USA). Plasma Physics Lab.); Dylla, H.F.; Manos, D.M.; Cohen, S.A.; Wampler, W.R.; Bastasz, R. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). DOE Contract AC02-76CH03073;AC04-76DP00789. (CONF-8805285–: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

Special limiter conditioning techniques using low density deuterium or helium discharges have produced enhanced plasma confinement in TFTR. Measurements with a rotatable collector probe have been made to increase our understanding of the boundary layer during these conditioning sequences. A set of silicon films behind slits facing in the ion and electron drift directions was exposed to four different D^+ and He^{2+} discharge sequences. The amounts of deuterium and impurities trapped in the surface regions of the samples have been measured by different analytical techniques, including nuclear reaction analysis for retained deuterium, Rutherford backscattering spectroscopy for carbon and metals, and Auger electron spectroscopy for carbon, oxygen and metals. Up to 1.9×10^{17} cm^{-2} of deuterium was detected in codeposited carbon layers with D/C generally in the range of the bulk saturation limit. Radial profiles and ion drift/electron drift asymmetries are discussed. (orig.).

46727 Release of deuterium from carbon during low-energy helium and carbon ion bombardment. Wampler, W.R. (Sandia National Labs., Albuquerque, NM (USA)); Doyle, B.L. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). (CONF-8805285–:).

Ion-induced release of deuterium (D) from carbon was investigated as a possible mechanism for the supershot conditioning in TFTR. Carbon was implanted to saturation with 300 eV D and then bombarded with 0.6 and 1.2 keV helium ions and 3 keV carbon ions. Nuclear reaction analysis was used to monitor the areal density of D remaining in the samples during the ion bombardment. Initial D release rates up to 10 D atoms per incident ion were observed. The amount of D that can be removed by ion-induced release from the TFTR limiter is similar to the pumping capacity produced by supershot-conditioning. A model for removal of D from the limiter by ion-induced release is described which agres with observed D removal during supershot conditioning in TFTR. (orig.).

46728 Helium-Ion-Induced release of hydrogen from graphite. Langley, R.A. (Oak Ridge National Lab., TN (USA)). *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands)*, 162-164: 164 (Apr 1989). DOE Contract AC05-84OR21400. (CONF-8805285–: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

The ion-induced release of hydrogen from AXF-5Q graphite was studied for 300- to 500-eV helium ions. The hydrogen was implanted into the graphite with a low energy ($\simeq$ 200 eV) and to a high fluence. This achieved a thin ($\simeq$ 10 nm),saturated near-surface region. The release of hydrogen was measured as a function of helium fluence. A model that includes ion-induced detrapping, retrapping, and surface recombination was used to analyze the experimental data. The release cross section varied from 1.8×10^{-16} cm^2 at 300 eV to 1.4×10^{-16} cm^2 at 500 eV, while the depletion depth varied from 0.8 nm at 300 eV to 1.2 nm at 500 eV. (orig.).

46729 Hydrogen Ion-driven permeation in carbonaceous films. Anderl, R.A. (Idaho National Engineering Lab., Idaho Falls (USA)); Holland, D.F.; Longhurst, G.R. *Journal of Nuclear Materials,*

on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands), 162-164: 164 (Apr 1989). DOE Contract AC07-76ID01570. (CONF-8805285--:).

This paper presents the results of investigations into the permeation properties of amorphous carbonaceous, a-C:H, films produced by plasmachemical deposition techniques. Carbonaceous films on iron substrates with thickness ranging from 60 nm to 110 nm were subjected to high fluence implantations with mass analyzed D_3^+ ions with energies ranging from 600 eV to 3000 eV and fluxes ranging from $5x10^{14}$ D/cm^2 s to $5x10^{15}$ D/cm^2 s, respectively. Deuterium re-emission upstream, deuterium permeation downstream and secondary ions sputtered from the implantation surface were measured as a function of implantation fluence for specimens at 420 K. The present studies indicate that the a-C:H film permeability is directly related to the time, hence the fluence, required to achieve isotopic replacement and saturation of the deuterium ion beam atoms stopped in the implant region. Once the deuterium saturation level is achieved in the layer, a significant fraction of the implanting ions can result in permeation. For the present experiment, this permeation factor was much higher than that for uncoated iron specimens subjected to similar beam conditions. Carbon sputter yields of 0.008-0.01 C/D were determined in this work for 1000-eV to 400-eV deuterium ions incident on a-C:H films. (orig.).

46730 Control of water absorption by purification of graphite. Simpkins, J.E. (Oak Ridge National Lab., TN (USA)); Strehlow, R.A.; Mioduszewski, P.K.; Uckan, T. *Journal of Nuclear Materials, on Metallurgy, Ceramics and Solid State Physics in the Nuclear Energy Industry (Netherlands),* 162-164: 164 (Apr 1989). DOE Contract AC05-84OR21400. (CONF-8805285--: 8. international conference on plasma surface interactions in controlled fusion devices (PSI-8), 2-6 May 1988).

It is well known that graphite can absorb large quantities of water, which can represent an abundant source of oxygen impurities in fusion plasmas if the corresponding components are not properly outgassed. We have outgassed various fusion-relevant graphites (e.g., POCO AXF-5Q) for 1.5 h at 1500^{0}C to release absorbed water and have subsequently exposed the samples to air for various periods of time. Re-absorption of water during the air exposure was estimated by measuring the amount of water produced in subsequent outgassing runs. The results show that the amount of water re-absorbed increases by a factor of approximately 10 within 8 h compared to the sample in the outgassed state but with no air exposure. The water content of the "as received" material is reached after approximately 30 days. Re-absorption of water was significantly reduced by purification of the investigated graphite samples. This purification process, which consists of heating the sample at 2800^{0}C for 30 min in an argon atmosphere, reduces the levels of trace impurities which can be responsible for catalytic surface reactions on the internal surfaces of the graphicte. After exposing an outgassed sample to an electron cyclotron heated plasma followed by 1 h air exposure, the amount of water desorbed was observed to increase by a factor of 6. Data will be presented to correlate this effect with trace impurities. (orig.).

46731 Fusion tritium program in the United States. Anderson, J.L. (Los Alamos National Lab., NM (USA). Materials Science and Technology Div.); Bartlit, J.R. *Fusion Technology (USA),* 14(2): 407-411 (Sep 1988). (CONF-880505--: 3. topical meeting on tritium technology in fission, fusion and isotopic applications, 1-6 May 1988).

The fusion technology development program for tritium in the U.S is centered around the Tritium Systems Test Assembly (TSTA) at Los Alamos National Laboratory. Objectives of this project are to develop and demonstrate the fuel cycle for processing the reactor exhaust gas (unburned deuterium and tritium plus impurities), and the necessary personnel and environmental protection systems for the next generation of fusion devices. The TSTA is a full-scale system for a machine the size of the International Tokamak Reactor (INTOR) or the International Thermonuclear Experimental Reactor (ITER). That is, TSTA has the capacity to process tritium in a closed loop mode at the rate of 1 kg per day, requiring a tritium inventory of about 100 g. The TSTA program also interacts with all other tritium-related fusion technology programs in the U.S. and all major programs abroad. This report is a summary of the results and interactions of the TSTA program since a previous summary was published and an overview of related tritium programs.

46732 Remotely replaceable Tokamak plasma limiter tiles. Remy, G. To Dept. of Energy, Washington, DC. USA Patent 4,816,205. 28 Mar 1989. Filed date 9 Dec 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

U-shaped limiter tiles placed end-to-end over a pair of parallel runners secured to a wall have two rods which engage L-shaped slots in the runners. The short receiving legs of the L-shaped slots are perpendicular to the wall and open away from the wall, while long retaining legs are parallel to and adjacent the wall. A sliding bar between the runners has grooves with clips to retain the rods pressed into receiving legs of the L-shaped slots in the runners. Sliding the bar in the direction of retaining legs of the L-shaped slots latches the tiles in place over the runners. Resilient contact strips between the parallel arms of the U-shaped tiles and the wall assure thermal and electrical contact with the wall.

46733 Current-level triggered plasma-opening switch. Mendel, C.W. To Dept. of Energy, Washington, DC. USA Patent 4,812,715. 14 Mar 1989. Filed date 29 Jun 1987. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

An opening switch for very high power electrical pulses uses a slow magnetic field to confine a plasma across a gap between two electrodes. The plasma conducts the electrical pulse across the gap while the switch is closed. A magnetic field generated by the pulse repels the slow magnetic field from the negative electrode to push the plasma from the electrode, opening the switch. A plurality of radial vanes may be used to enhance the slow magnetic field.

46734 Cr^{3+}-doped colquirlite solid state laser material. Payne, S.A.; Chase, L.L.; Newkirk, H.W.; Krupke, W.F. To Dept. of Energy, Washington, DC. USA Patent 4,811,349. 7 Mar 1989. Filed date 31 Mar 1988. vp. Available from Patent and Trademark Office, Box 9, Washington, DC 20232.

Chromium doped colquiriite, $LiCaAlF_6:Cr^{3+}$, is useful as a tunable laser crystal that has a high intrinsic slope efficiency, comparable to or exceeding that of alexandrite, the current leading performer of vibronic sideband Cr^{3+} lasers. The laser output is tunable from at least 720 nm to 840 nm with a measured slope efficiency of about 60% in a Kr laser pumped laser configuration. The intrinsic slope efficiency (in the limit of large output coupling) may approach the quantum defect limited value of 83%. The high-slope efficiency implies that excited state absorption (ESA) is negligible. The potential for efficiency and the tuning range of this material satisfy the requirements for a pump laser for a high density storage medium incorporating Nd^{3+} or Tm^{3+} for use in a multimegajoule single shot fusion research facility.

99 GENERAL AND MISCELLANEOUS

Refer also to citation(s) 45177

46735 (DOE/FE--0130) **Liquefied Gaseous Fuels Spill Test Facility.** USDOE Assistant Secretary for Fossil Energy, Washington, DC (USA). [1989]. 7p. Sponsored by U.S. DOE Fossil Energy. Order Number DE89015574/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The US Department of Energy's Liquefied Gaseous Fuels Spill Test Facility is a research and demonstration facility available on a user-fee basis to private and public sector test sponsors concerned with safety aspects of hazardous chemicals. Though initially designed to accommodate large liquefied natural gas releases, the Spill Test Facility (STF) accommodates safety-related testing of most chemicals in commercial use. The Facility is located at DOE's Nevada Test Site near Mercury, Nevada, USA. The Spill Test Facility is the only facility of its kind for either large- or small-scale testing of hazardous and toxic fluids with the added capability of large-scale wind tunnel testing under controlled conditions. It is ideally suited for users to develop verified data on prevention, mitigation, clean-up, and environmental effects of toxic and hazardous gaseous liquids. This document is designed to briefly acquaint a potential user of the Spill Test Facility with an outline of the procedures and policies associated with the use of the facility.

46736 (DOE/MA/00356–H4) **1989 National Compensation Survey of Research and Development Scientists and Engineers: Final report: Data effective date: January 15, 1989.** Hay Group, Washington, DC (USA). May 1989. 424p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC01-86MA00356. Order Number DE89015175/JAW. Available from NTIS, PC A18/MF A01 - OSTI; GPO Dep.

This report presents the results of the third in a new series of surveys of compensation and benefits for research and development (R&D) scientists and engineers (S&Es). The 1989 Survey represents the largest nationwide database of its kind, covering 102 establishments which provided data on almost 36,000 degreed researchers in the "hard" sciences.

46737 (SAND–89-1492) **Equation typing: Guidelines for Mass-11 users and others.** Jackson, C.L. Sandia National Labs., Albuquerque, NM (USA). Jun 1989. 73p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89015165/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A number of problems have been experienced by Sandia secretaries and others in the preparation of equations. This report is a self- paced/"how-to" manual designed to provide detailed explanations on the preparation of equations using Mass-11 and the typewriter and is suitable for either classroom training or on-the-job use.

9901 Management

Refer also to citation(s) 45081, 45308, 46425

46738 (AECL–9263) **Progress report - Physics and Health Sciences - Health Sciences Section - 1986 January 01 - June 30.** Atomic Energy of Canada Ltd., Chalk River, ON (Canada). Chalk River Nuclear Labs. Aug 1986. 118p. (PR-PHS-HS–1). Order Number DE89635689/JAW. Available from NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS.

This progress report contains a summary of major research in the Health Sciences Division. Separate chapters are included for each of the following branches: Dosimetric Research, Environmental Research, Radiation Biology, and Medical Biophysics. Some of the aspects discussed include measurement and application of environmental isotopes (e.g., Strontium 85, Strontium 90, Tritium), environmental processes of radioisotope transport (e.g. ground water) dosimetry and employee monitoring, the effects of ionizing radiation on living cells (cancer, hyperthermia, DNA, etc.).

46739 (LA-UR–89-2027) **Difficulties implementing a quality assurance program at a national laboratory.** Bussolini, P.L. Los Alamos National Lab., NM (USA). 1989. 8p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-36. (CONF-8909110–3: 16. annual conference of the American Society for Quality Control, 17-20 Sep 1989). Order Number DE89014315/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Personnel who perform scientific research are highly educated, highly motivated professionals who are often leaders in their fields. A recent survey of researchers at Los Alamos shows that they like freedom and peer recognition, and dislike red tape. Rigid, prescriptive quality assurance programs are often fail because they are perceived to limit freedom and peer recognition and enhance red tape. This paper will present some of the reasons for research personnel to have rebelled against quality assurance programs and will offer suggestions for the development of a meaningful and successful quality program.

46740 (NUREG–0325-Rev.12) **U.S. Nuclear Regulatory Commission functional organization charts.** Nuclear Regulatory Commission, Washington, DC (USA). Office of Personnel. 1 Jul 1989. 63p. Sponsored by Nuclear Regulatory Commission. Available from NTIS, PC A04/MF A01 - GPO - OSTI.

Functional organization charts for the US Nuclear Regulatory Commission offices, divisions and branches are presented.

9902 Mathematics and Computers

Refer also to citation(s) 44439, 44622, 44663, 44678, 44679, 44759, 44763, 44821, 44822, 44823, 44987, 44997, 45006, 45032, 45072, 45113, 45129, 45172, 45228, 45326, 45378, 45392, 45516, 45587, 45744, 45745, 45752, 45760, 45765, 45769, 45775, 45780, 45781, 45854, 45873, 45894, 45902, 46010, 46034, 46035, 46061, 46196, 46197, 46354, 46418, 46422, 46563, 46565, 46612, 46632, 46634, 46660, 46670, 46786, 46787, 46789

46741 (AD-A–207792/3/XAB) **Model of parallel performance. Final report, July-December 1988.** Carmona, E.A.; Rice, M.D. Air Force Weapons Lab., Kirtland AFB, NM (USA). Apr 1989. 50p. (AFWL-TR–89-01). Available from NTIS, PC A03/MF A01.

This report introduces a general model of parallel performance. With the goal of developing conceptual and empirical methods for characterizing and understanding parallel algorithms, new definitions of speedup and efficiency were formulated. These definitions take into account the effects that problem size and the number of processors have on efficiency and speedup, and provide a natural and quantifiable measure of parallel performance. The terms introduced in the definitions provide new and improved interpretations of the 'serial' and 'parallel' fraction parameters commonly used in the literature (i.e., Amdahl's Law) to explain the behavior of parallel algorithms. The model provides a more complete characterization of parallel algorithm behavior and is used to correct apparent deficiencies in the formulation of speedup as expressed by Amdahl's Law. Chapter 2 of this report reviews the basic definitions of speedup and efficiency and introduces new definitions of these quantities in terms of work units and presents two illustrative examples. Chapter 3 discusses two models of parallel performance that appear in the parallel computing literature. The two formulations of speedup and efficiency are based on the notion of 'serial' and 'parallel' fractions and present an apparent dichotomy that must be resolved. Then, the 'serial' and 'parallel' fractions are expressed in terms of the new work quantities introduced in Chapter 2, providing a natural interpretation of the serial and parallel fractions of a task. The resulting equations are used to reconcile the (apparent) dichotomy between Amdahl's Law and the more recent formulation of speedup.

46742 (AD-A–207802/0/XAB) **Information requirements and the implications for parallel computation. Doctoral thesis.** Worley, P.H. Stanford Univ., CA (USA). Dept. of Computer Science. Jun 1988. 149p. (STAN-CS–88-1212). Available from NTIS, PC A07/MF A01.

Sponsored in part by Contract N00014-75-C-1132 and Grant DE-AC05-84OR21400.

The best serial algorithms for numerically approximating the solution of a linear partial differential equation (PDE) exploit knowledge of the solution operator. This dissertation describes how the solution operator also influences the behavior of parallel algorithms. Approximating the solution at a single location in the problem domain is considered. A lower bound on the error in the approximation is derived that is a function of the amount of data used and the smoothness of the data functions. From this one can derive a lower bound on the parallel complexity of algorithms that approximate the solution. The lower bound is a linear function of log 1/epsilon, where epsilon is an upper bound on the error. Thus the parallel complexity increases as epsilon decreases, independent of the number of processors used. An algorithm is also constructed whose parallel complexity is of this form, proving that the form of the bound is the best possible. The execution time of parallel algorithms is a function of both the communication costs and the parallel complexity. We describe bounds on the communication cost of parallel algorithms that are functions of the distance between collaborating processors. If the interconnection network of a multiprocessor is a D dimensional grid, then we prove that the execution time of algorithms that approximate the solution is bounded from below by a linear function of epsilon exp(-gamma/(d + 1)), where gamma is a positive constant determined by the smoothness of the data functions. Thus, for small epsilon, the communication costs are the dominant constraints on the optimal performance.

46743 (AD-A–207807/9/XAB) **Intelligent mathematical modeling system - MATHMODEL. Final report, 1 August 1988-31**

March 1989. Lock, X.G.; Prywes, N. Computer Command and Control Co., Philadelphia, PA (USA). 31 Mar 1989. 69p. Available from NTIS, PC A04/MF A01.

A system, called MATHMODEL was developed by Lock in his research at the University of Pennsylvania. It is a very complex and large multi-phase system. It consists of 142 modules and 60,000 lines of PL/1 code. MATHMODEL is based on an old (1984) version of MODEL system, which automatically translates equational specifications into highly efficient programs in PL/1. Computer Command and Control Company (CCCC) has a much more advanced and reliable version of MODEL that generates programs in several languages (PL/1, C and Ada) and that runs on several computers (IBM and Digital). It also generates programs that can be executed in parallel on distributed computers. Most important, CCCC's MODEL contains many more operations useful in mathematical modeling (e.g. matrix algebra, relational algebra, etc.) This version is much more reliable and robust and is well documented. The project has merged MATHMODEL's capabilities with those of CCCC's MODEL and has transformed MATHMODEL into a greatly more effective tool for mathematical modeling than any system developed to date.

46744 (AD-A-207814/5/XAB) **Radon transform analysis of a probabilistic method for image generation. Annual report No. 2, 1 April 1988-31 March 1989.** Berger, M.A. Carnegie-Mellon Univ., Pittsburgh, PA (USA). 12 Apr 1989. 20p. Available from NTIS, PC A03/MF A01.

The research performed for this grant over the past year involved affine iterated function system (IFS) encoding and IFS mixing for digital images. This relates to a technique of Michael Barnsley's for generating fractal and other images by randomly iterating affine transformations of the plane into itself. By this technique an image is both generated and represented as the long-term probability distribution for a 2-D or 3-D Markov chain. The encoding involves finding an affine 'collage' of the image, whereby it is identified as a convex combination of affinely scaled versions of itself. This permits some remarkable data compression. The mixing involves a merging of IFS's so as to produce images with combined textures. It ties in with the encoding in that a broader class of images can then be efficiently encoded, and there are more degrees of freedom in the encoding search. The mathematical methods used involve stochastic optimization, computational geometry, the Radon transform, dynamical systems and ergodic theory for Markov chains.

46745 (AD-A-207820/2/XAB) **Analysis of cache invalidation patterns in multiprocessors.** Weber, W.D.; Gupta, A. Stanford Univ., CA (USA). Computer Systems Lab. 1989. 20p. Available from NTIS, PC A03/MF A01.

To make shared-memory multiprocessors scalable, researchers are now exploring cache coherence protocols that do not rely on broadcast, but instead send invalidation messages to individual caches that contain stale data. The feasibility of such directory-based protocols is highly sensitive to the cache invalidation patterns that parallel programs exhibit. This paper analyzes the cache invalidation patterns caused by several parallel applications and investigate the effect of these patterns on a directory-based protocol. Results are based on multiprocessor traces with 4, 8 and 16 processors. To get insight into what the invalidation patterns would look like beyond 16 processors, a classification scheme is proposed for data objects found in parallel applications and link the invalidation traffic patterns observed in the traces back to these high-level objects. Results show that synchronization objects have very different invalidation patterns from those of other data objects. A write reference to a synchronization object usually causes invalidations in many more caches. Situations are noted where restructuring the application seems appropriate to reduce the invalidation traffic, and others where hardware support is more appropriate. Results also show that it should be possible to scale 'well-written' parallel programs to a large number of processors without an explosion in invalidation traffic.

46746 (AD-A-207827/7/XAB) **Two-dimensional signal processing and storage and theory and applications of electromagnetic measurements. Annual report, 1 January-31 December 1988.** Schafer, R.W.; Paris, D.T. Georgia Inst. of Tech., Atlanta, GA (USA). School of Electrical Engineering. 1 Jan 1989. 44p. Available from NTIS, PC A03/MF A01.

This is an annual report on research conducted under the auspices of the Joint Services Electronics Program. Specific topics covered are: digital signal processing, parallel processing architectures, two-dimensional optical storage and processing, hybrid optical/digital signal processing, electromagnetic measurements in the time domain, and automatic radiation measurements for near-field and far-field transformation.

46747 (AD-A-207842/6/XAB) **Characterization of parallelism and deadlocks in distributed digital logic simulation. Draft report.** Soule, L.; Gupta, A. Stanford Univ., CA (USA). Computer Systems Lab. 3 Nov 1988. 15p. Available from NTIS, PC A03/MF A01.

This paper explores the suitability of the Chandy-Misra algorithm for digital logic simulation. Four realistic circuits are used as benchmarks for the analysis, with one of them being the vector-unit controller for the Titan supercomputer from Ardent. The results show that the average number of logic elements available for concurrent execution ranges from 6.2 to 92 for the four circuits, with an overall average of 50. Although this is twice as much parallelism as that obtained by traditional event-driven algorithms, it is still felt too low. One major factor limiting concurrency is the large number of global synchronization points - deadlocks in the Chandy-Misra terminology - that occur during execution. Towards the goal of reducing the number of deadlocks, the paper presents a classification of the types of deadlocks that occur during digital logic simulation. Four different types are identified and described both intuitively in terms of circuit structure and formally with equations. Using domain specific knowledge, the paper proposes methods for reducing these deadlock occurrences. For one of the benchmark circuits, the use of the proposed techniques eliminated all deadlocks and increased the average parallelism from 40 to 160. We believe that the use of such domain knowledge will make the Chandy-Misra algorithm significantly more effective than it would be in its generic form. (jhd)

46748 (CONF-881054--Vol.1, pp. 33-44) **Compliance program data management system for the Idaho National Engineering Laboratory/Environmental Protection Agency.** Hertzler, C.L. (EG and G Idaho, Inc., Idaho Falls (USA)); Poloski, J.P.; Bates, R.A.; Van Haaften, D.H.; Shea, J.P.; Fritz, L.L. Analysas Corp., Oak Ridge, TN (USA). 1988. DOE Contract AC07-76ID01570. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

The Compliance Program Data Management System (DMS) developed at the Idaho National Engineering Laboratory (INEL) validates and maintains the integrity of data collected to support the Consent Order and Compliance Agreement (COCA) between the INEL and the Environmental Protection Agency (EPA). The system uses dBase III Plus programs and dBase III Plus in an interactive mode to enter, store, validate, manage, and retrieve analytical information provided on EPA Contract Laboratory Program (CLP) forms and CLP forms modified to accommodate 40 CFR 264 Appendix IX constituent analyses. Data analysis and presentation is performed utilizing SAS, a statistical analysis software program. Archiving of data and results is performed at appropriate stages of data management. The DMS is useful for sampling and analysis programs where adherence to EPA CLP protocol, along with maintenance and retrieval of waste site investigation sampling results is desired or requested.

46749 (CONF-881054--Vol.1, pp. 45-54) **Using online information for hazard assessment.** Reed, K.L. (Oak Ridge Associated Universities, TN (USA)); Carroll, E.W. Analysas Corp., Oak Ridge, TN (USA). 1988. DOE Contract AC05-76OR00033. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Increasingly more databases are available online to assist in the process of hazard assessment as required by CERCLA, SARA, RCRA, and similar legislation. This paper discusses the utility of data files available through the National Library of Medicine (NLM) for completing health assessment and the role of training in making more effective use of such systems. The authors discuss (1) how online information can be used to complete hazard assessments, (2) how training can be developed to support effective use of online

files, and (3) the importance of user support systems in connecting database users with the information they need. The discussion draws on knowledge and experience gained in developing training systems for the US Department of Energy, Department of Energy contractors, the National Library of Medicine, the Agency for Toxic Substances and Disease Registry, and state public health officials.

46750 (CONF-881054–Vol.1, pp. 65-77) **Evaluating historical environmental data.** Price, J.B. (Roy F. Weston, Inc., Albuquerque, NM (USA)); Wood, C.J. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

When conducting most remedial investigation/feasibility studies (RI/FS), there usually exists some previously collected data. These data have potential for use in the RI/FS if these data can be systematically reviewed and assigned a level of acceptability based on their intended use. The usefulness and utilization of these existing data requires a determination of there relevancy, validity, sufficiency, and, integrity. This determination is accomplished through a process called data acceptance. The objective of this process is to evaluate compliance to US DOE and EPA guidance on Quality Assurance/Quality Control (QA/QC). This process supports a realization of cost-effectiveness which implies that historical data must be discarded only with cause, while the realization of quality assurance directs that this data be accepted only with cause. To evaluate this previously collected data in a cost-effective manner, the data are organized in a hierarchical manner, according to the dependences of the data. This allows the discarding of some dependent data without an extensive and costly review, based on the discarding of the data that they depend on. Several criteria may be used to judge the acceptability of data. These include sufficiency of data reporting, the presence and sufficient documentation of QA/QC, the documentation of custody, and the validity of sampling and analysis methodology. In summary, historical environmental data can be used in the RI/FS decision making and engineering if a determination of the data quality can be established.

46751 (CONF-881054–Vol.1, pp. 79-90) **Systems analysis support to the waste management technology center.** Rivera, A.L.; Osborne-Lee, I.W.; DePaoli, S.M. Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

This paper describes a systems analysis concept being developed in support of waste management planning and analysis activities for Martin Marietta Energy Systems, Inc. (Energy Systems), sites. This integrated systems model serves as a focus for the accumulation and documentation of technical and economic information from current waste management practices, improved operations projects, remedial actions, and new system development activities. The approach is generic and could be applied to a larger group of sites. This integrated model is a source of technical support to waste management groups in the Energy Systems complex for integrated waste management planning and related technology assessment activities. This problem-solving methodology for low-level waste (LLW) management is being developed through the Waste Management Technology Center (WMTC) for the Low-Level Waste Disposal, Development, and Demonstration (LLWDDD) Program. In support of long-range planning activities, this capability will include the development of management support tools such as specialized systems models, data bases, and information systems. These management support tools will provide continuing support in the identification and definition of technical and economic uncertainties to be addressed by technology demonstration programs. Technical planning activities and current efforts in the development of this system analysis capability for the LLWDDD Program are presented in this paper.

46752 (CONF-881054–Vol.1, pp. 355-366) **Groundwater extraction and disposal program to control off-site migration of soluble petroleum hydrocarbons.** Hall, P.J. (E. C. Jordan Co. (USA)). Analysas Corp., Oak Ridge, TN (USA). 1988. From 4. annual DOE model conference; 3-7 Oct 1988. In *1988 DOE model conference proceedings. Volume 1.* Order Number DE89014700/JAW. Available from NTIS, PC A15/MF A01.

Petroleum contamination has occurred at a fuel storage facility in New Jersey resulting in both floating fuel product and dissolved benzene, toluene, and xylene (BTX) chemicals in groundwater. Based on the distribution and concentrations of the BTX chemical plume, a remedial action program was developed to control off-site migration of chemicals. The site itself overlies a shallow sand and gravel aquifer which has slight downward vertical gradients and horizontal flow rates estimated at 6 to 10 feet per year. Current analytical data show the dissolved plume to be generally narrow in width and migrating in the same direction as groundwater flow. A multi-well groundwater extraction system was designed to capture dissolved petroleum hydrocarbons while creating a minimal hydrologic impact to free-product located near the contaminant source. A separate hydrocarbon recovery system will be utilized to remove the floating fuel product. As part of this program, several disposal options were evaluated to discharge effluent from an activated carbon filter treatment process. These alternatives included an off-site leachfield, discharge to a publicly owned treatment facility (POTW), and a leachfield located at the site. The development of the extraction system was completed using both analytical and numerical groundwater flow models. The feasibility of the disposal alternatives was verified through additional modeling and an evaluation of permit requirements.

46753 (CONF-890814–6) **Systems analysis considerations in artificial intelligence/expert systems technology applications.** Rivera, A.L. Oak Ridge National Lab., TN (USA). [1989]. 12p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From American Institute of Chemical Engineer's summer national meeting; 20-23 Aug 1989. Order Number DE89016847/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The concept of artificial intelligence (AI) represents a challenging opportunity in expanding the potential benefits from computer systems. The potential of this concept lies in facilitating the development of intelligent computer systems to help analysts and decision-makers in problem solving in the same way that machines support the laborer. Because the knowledge of human experts is an essential input to many parts of chemical process planning, development, and operation, there are numerous opportunities for the applications of expert systems (a product from AI) in chemical engineering. Intelligent computer systems could be developed by chemical engineers to increase the contribution of computer technology to the advancement of the profession, particularly in the strategic management of the scientific and technological aspects of chemical engineering applications. This paper introduces systems analysis as a framework for the planning and development of intelligent computer systems in those areas where chemical engineering could play a significant role. 11 refs., 9 figs.

46754 (CONF-8905198–1) **An example of a reaction-diffusion system with nonlinear competitive interactions.** Protopopescu, V. Oak Ridge National Lab., TN (USA). [1989]. 12p. Sponsored by U.S. Department of Defense. DOE Contract AC05-84OR21400. From 11. international conference on transport theory; 22-26 May 1989. Order Number DE89016223/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

An example of a parabolic system with nonlinear local or nonlocal interactions is considered with specific applications to the description of competition situations. Under suitable assumptions on the interaction terms, one can derive global existence as well as a comparison result between the PDE solutions and the "lumped" (space-integrated) ODE solutions. The uniqueness issue for the stationary state of the system – corresponding to a stalemate – is also considered. The discrete version of the system is then constructed and some preliminary results for the two-species one-index map and for the one-species two-index map are discussed. 10 refs.

46755 (CONF-8908121–1) **Electronic Forms-EARS [Electronic Authorization and Routing System] Beta Test Pilot Project: Final report.** Smith, P.T. Oak Ridge National Lab., TN (USA). Aug 1989. 29p. Sponsored by U.S. DOE Energy Research. DOE Contract AC05-84OR21400. From Electronic Authorization and Routing System EARS meeting; 7 Aug 1989. Order Number DE89016078/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

The Electronic Forms-EARS Beta Test Pilot Project is a Martin Marietta Energy Systems' project designed to accomplish the combined goals of beta testing the Electronic Authorization and Routing System (EARS) software and testing the routing of Energy Systems designed forms using the EARS software. The Electronic Authorization and Routing System (EARS) is a joint project of DOE/ALO, Sandia National Laboratory at Albuquerque (SNLA), Savannah River Plant, and Digital Equipment Corporation (DEC). The purpose of the system is to provide a controlled, automated system for documents which may require signatory approvals through a routine or designated ad hoc chain of reviewers. Alpha testing was completed at SNLA during the fall of 1988 and beta testing was begun at selected DOE sites during the spring of 1989.

46756 (CONF-8909127–1) **An integrated diagnostic system for a process controller.** Mullens, J.A.; Williams, L.C.; Zabriskie, W.L. Oak Ridge National Lab., TN (USA). 1989. 6p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. From 1. international machinery monitoring and diagnostic conference; 11-14 Sep 1989. Order Number DE89012509/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The Oak Ridge National Laboratory Instrumentation and Controls Division is developing an integrated diagnostic system to aid a technician in diagnosing faults in a complex process controller. The integrated diagnostic system, which is being developed to run on 80386 machines in the Smalltalk language, will include an expert system to make a diagnosis, an on-line "hypermedia" manual (which includes equipment manuals and video) to supply additional help and reference material, and an automated procedure guide to take the technician through complex procedures for tasks such as parts replacement. 3 refs., 6 figs.

46757 (DOE/ER/25009–806) **Applications of parallel supercomputers: Scientific results and computer science lessons.** Fox, G.C. California Inst. of Tech., Pasadena, CA (USA). 12 Jul 1989. 92p. Sponsored by U.S. DOE Energy Research. DOE Contract FG03-85ER25009. (CONF-8903158–1: Inaugural symposium for Center for Science and Technology, 2 Mar 1989). Order Number DE89016385/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

Parallel Computing has come of age with several commercial and inhouse systems that deliver supercomputer performance. We illustrate this with several major computations completed or underway at Caltech on hypercubes, transputer arrays and the SIMD Connection Machine CM-2 and AMT DAP. Applications covered are lattice gauge theory, computational fluid dynamics, subatomic string dynamics, statistical and condensed matter physics,theoretical and experimental astronomy, quantum chemistry, plasma physics, grain dynamics, computer chess, graphics ray tracing, and Kalman filters. We use these applications to compare the performance of several advanced architecture computers including the conventional CRAY and ETA-10 supercomputers. We describe which problems are suitable for which computers in the terms of a matching between problem and computer architecture. This is part of a set of lessons we draw for hardware, software, and performance. We speculate on the emergence of new academic disciplines motivated by the growing importance of computers. 138 refs., 23 figs., 10 tabs.

46758 (EPRI-NP–6507) **Application of modern computer technology to EPRI [Electric Power Research Institute] nuclear computer programs: Final report.** Feinauer, L.R. Electric Power Research Inst., Palo Alto, CA (USA); Power Computing, Dallas, TX (USA). c Aug 1989. 102p. Sponsored by Electric Power Research Institute. Available from Research Reports Center, Box 50490, Palo Alto, CA 94303.

Many of the nuclear analysis programs in use today were designed and developed well over a decade ago. Within this time frame, tremendous changes in hardware and software technologies have made it necessary to revise and/or restructure most of the analysis programs to take advantage of these changes. As computer programs mature from the development phase to being production programs, program maintenance and portability become very important issues. The maintenance costs associated with a particular computer program can generally be expected to exceed the total development costs by as much as a factor of two. Many of the problems associated with high maintenance costs can be traced back to either poorly designed coding structure, or "quick fix" modifications which do not preserve the original coding structure. The lack of standardization between hardware designs presents an obstacle to the software designer in providing 100% portable coding; however, conformance to certain guidelines can ensure portability between a wide variety of machines and operating systems. This report presents guidelines for upgrading EPRI nuclear computer programs to conform to current programming standards while maintaining flexibility for accommodating future hardware and software design trends. Guidelines for development of new computer programs are also presented. 22 refs., 10 figs.

46759 (JAERI-M–89-012) **Proceedings of the fifth seminar on software development in nuclear energy research.** Hasegawa, Akira; Maekawa, Hiroshi; Fujiki, Kazuo; Harada, Hiroo (eds.) (Japan Atomic Energy Research Inst., Tokai, Ibaraki (Japan). Tokai Research Establishment). Japan Atomic Energy Research Inst., Tokyo (Japan). Feb 1989. 205p. (In Japanese). (CONF-8810416–: 5. seminar on software development in nuclear energy research, 17-18 Oct 1988). Order Number DE89906455/JAW. Available from NTIS (US Sales Only), PC A10/MF A01.

These proceedings are the compilations of papers presented to the Fifth Seminar on Software Development in Nuclear Energy Research held at Tokai Research Establishment, Japan Atomic Energy Research Institute (JAERI), October 17 - 18, 1988. The seminar was organized in cooperation with Japanese Committee on Reactor Physics (JCRP) and Japanese Nuclear Code Committee (JNCC). The topics of seminar include the invited papers on the subjects: - Net work for Atomic Energy Research - (1) Present and future of Networks, (2) Applications of Networks, (3) Panel Discussion : Usage of Networks in Atomic Energy Research, - Frontier of Simulation Softwares for the Environment Safety - (4) Numerical Simulation of Global Scale Dispersion on the Chernobyl Accident, and (5) Oceanic Diffusion and Safety Evaluation of High Level Waste Disposal in Geological Media. (author).

46760 (LA-UR–89-2706) **An integrated distributed processing interface for supercomputers and workstations.** Campbell, J.; McGavran, L. Los Alamos National Lab., NM (USA). [1989]. 9p. Sponsored by U.S. DOE Management & Administration. DOE Contract W-7405-ENG-36. (CONF-890941–2: Conference on applications of supercomputers in engineering, 5-7 Sep 1989). Order Number DE89016769/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Access to documentation, communication between multiple processes running on heterogeneous computers, and animation of simulations of engineering problems are typically weak in most supercomputer environments. This presentation will describe how we are improving this situation in the Computer Research and Applications group at Los Alamos National Laboratory. We have developed a tool using UNIX filters and a SunView interface that allows users simple access to documentation via mouse driven menus. We have also developed a distributed application that integrated a two point boundary value problem on one of our Cray Supercomputers. It is controlled and displayed graphically by a window interface running on a workstation screen. Our motivation for this research has been to improve the usual typewriter/static interface using language independent controls to show capabilities of the workstation/supercomputer combination. 8 refs.

46761 (LBL–26601) **Effective resource utilization for multiprocessor join execution.** Murphy, M.C.; Rotem, D. Lawrence Berkeley Lab., CA (USA). Jan 1989. 10p. Sponsored by U.S. DOE Energy Research. DOE Contract AC03-76SF00098. (CONF-8908116–1: 15. international conference on very large data bases, 22-25 Aug 1989). Order Number DE89016303/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Conventional approaches to execution of database queries on general purpose multiprocessors attempt to maximize system throughput using inter-query parallelism with a fixed number of processors. Standard uniprocessor optimization techniques are used to minimize execution time of individual queries. Our approach is to increase performance by utilizing intra-query parallelism as well as minimizing overall resource requirements. Specifically, processor and i/o bandwidth requirements are minimized by coordinating the

order in which data pages are read into memory and page joins assigned to available processors. We present a scheduling strategy based on join indices and prove lower and upper bounds on its resource requirements. We then describe a heuristic for estimating the number of processors required to complete join execution in minimal time. Our simulation results indicate that these techniques are effective with respect to processor utilization and buffer requirements. 11 refs.

46762 (N–89-23184) **Parallel processors and nonlinear structural dynamics algorithms and software. Semiannual progress report, 1 March-31 August 1988.** Belytschko, T. Northwestern Univ., Evanston, IL (USA). Apr 1989. 36p. (NASA-CR–184938;NAS–1.26:184938). Available from NTIS, PC A03/MF A01.

A nonlinear structural dynamics finite element program was developed to run on a shared memory multiprocessor with pipeline processors. The program, WHAMS, was used as a framework for this work. The program employs explicit time integration and has the capability to handle both the nonlinear material behavior and large displacement response of 3-D structures. The elasto-plastic material model uses an isotropic strain hardening law which is input as a piecewise linear function. Geometric nonlinearities are handled by a corotational formulation in which a coordinate system is embedded at the integration point of each element. Currently, the program has an element library consisting of a beam element based on Euler-Bernoulli theory and trianglar and quadrilateral plate element based on Mindlin theory.

46763 (PB–89-185367/XAB) **MSP modelling of concurrent processes. Version 1.00. General introduction and directions for use.** Mebius, J.E. Technische Hogeschool Delft (Netherlands). Dept. of Mathematics and Informatics Computer Science. 1988. 24p. (REPT–88-88). Available from NTIS, PC EE03/MF A01.

MSP is an interactive system for running models of systems of concurrent processes (henceforth often called concurrent systems). MSP runs a concurrent system according to the single-processor model with interleaving of process steps as permitted by the concurrent system's process texts. For each concurrent system to be run under MSP, a so-called model is created. The model takes the form of a ready-to-run Turbo-PASCAL program which consists of a general framework, common to all models, and a specific part, which consists essentially of the process texts of the concurrent system in question. The next paragraph explains how processes are represented in MSP. The framework may be conceived as a rudimentary operating system, whereas the process texts may be thought of as representing tasks to be run by that operating system. A difference from real-life operating systems is of course that in a MSP model the OS and the tasks are integrated into a fixed whole.

46764 (PNL-SA–17221) **Principal components in multivariate control charts.** Eggett, D.L.; Pulsipher, B.A. Pacific Northwest Lab., Richland, WA (USA). Aug 1989. 22p. Sponsored by U.S. DOE Nuclear Energy. DOE Contract AC06-76RL01830. (CONF-8908108–2: American Statistical Association meeting, 9 Aug 1989). Order Number DE89016828/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Principal components have been used as a variable reduction technique. The principal component scores have desirable statistical properties when the original variables are distributed as multivariate normal. In this paper, three statistics derived from the PC scores and used to form multivariate control charts are examined. These statistics are outlined and their distributional properties reviewed. The effectiveness of control charts using the three statistics was examined through Monte Carlo simulations. Several parameters were varied including correlation pattern, size of changes in means and variances, number of means or variances changed, change in the correlation for one variable, and the number of PCs retained. 3 refs., 9 tabs.

46765 (SAND–88-2896) **Evaluation of integrals related to the Debye function.** Amos, D.E. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 8p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. Order Number DE89016930/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

Certain models for the penetration and perforation of metal plate targets impacted by high velocity projectiles lead to integrals related to the Debye function. These integrals are numerically evaluated by a combination of series expansions near singularities and numerical quadrature away from singularities. Numerical evaluation of the Riemann zeta function and dilogarithm function for small parameters are by-products of this analysis. 5 refs., 1 fig.

46766 (SAND–89-0220C) **Optical coherence multiplexing for interprocessor communications.** Chu, K.W.; Dickey, F.M. Sandia National Labs., Albuquerque, NM (USA). 1989. 13p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909177–1: Optical engineering/fibers '89 meeting, 5-8 Sep 1989). Order Number DE89016186/JAW. Available from NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.

The development of an optical circuit that multiplexes gigabit-per-second electronic data streams into a very broad bandwidth (greater than 10 Gbit/s) optical signal would greatly enhance interprocessor communications in a parallel computer. One possibility that we are investigating is coherence multiplexing. In this method, time delays exceeding the coherence time of the light source are used to achieve multiplexing. We have analyzed the limitations of coherence multiplexing for high-speed data links. For the geometry that we are investigating, the analysis shows that the signal decreases inversely as the square of the number of channels. Noise sources include photon shot noise, excess noise (classical optical field fluctuations) and detector noise. A suitable optical source must have a smooth broad spectrum. Superluminescent diodes or edge emitting diodes are the best candidates. We show how all these factors affect the total information transfer rate. An integrated optical circuit for coherence multiplexing is being designed and built. This device is an array of four Mach-Zehnder interferometers integrated on a lithium niobate substrate. The differential delays will be achieved using proton exchange. Each interferometer will have two sets of electrodes, one for signal modulation and a second for fine adjustments of the delay. 31 refs., 9 figs.

46767 (SAND–89-1055) **LEXER: A tool for lexical analysis of program input.** Kephart, E.M.; Selleck, C.B. Sandia National Labs., Albuquerque, NM (USA); RE/SPEC, Inc., Albuquerque, NM (USA). Aug 1989. 28p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (RSI–0327). Order Number DE89016924/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

LEXER is a useful tool for lexical analysis. It is designed to give an application programmer the ability to write code that will quickly parse commands to an interactive program. It is also useful in parsing character data stored in a file. This is done by lexically analyzing the input character string and placing its components and related information into arrays stored in common blocks. The code is written in FORTRAN which conforms to the ANSI Standard FORTRAN 77 in all but a few carefully documented areas. 2 refs.

46768 (SAND–89-1452C) **New supercomputer market segments in manufacturing.** Bray, O.H. Sandia National Labs., Albuquerque, NM (USA). 1989. 10p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909139–1: Meeting on supercomputers: emerging applications in manufacturing, 11-13 Sep 1989). Order Number DE89013070/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

The supercomputer industry is at a crossroads. While its traditional markets have become relatively mature, the industry is becoming more competitive, especially with the challenge from Japan. The industry can either fight over this stable market or dramatically expand the market. The choice is obvious, but what are these new markets and how to approach them. This paper addresses these issues. First, it explains how the traditional definition of a supercomputer seriously constrains its market. An alternate definition opens up a much larger, emerging market. Second, it describes a market segmentation two barriers preventing customer in these new segments from using supercomputing and describes mechanisms to reduce and/or eliminate these barriers. Third, it discusses the portfolio analysis strategy to determine the markets in these new segments on which to concentrate. Obviously, parts of manufacturing are key targets. Finally, it draws some conclusions in terms of two scenarios – one which describes a healthy, growing

US supercomputer industry, the alternative showing the industry rapidly following the footsteps of the US consumer electronics industry. 6 refs.

46769 (SAND–89-1542C) **GaAs ASIC design case study.** Heise, J.A. Sandia National Labs., Albuquerque, NM (USA). 1989. 3p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC04-76DP00789. (CONF-8909146–2: 2. annual IEEE/ASIC seminar and exhibit, 25-28 Sep 1989). Order Number DE89013934/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

With increasing demands on system requirements, designers must look for new alternatives to successfully complete their goals. One alternative that offers designers many benefits is ASICs. They maximize device functionality while minimizing system space. Also as operating frequencies approach gigahertz speeds, ASICs allow specialized placement of functional blocks on chip to minimize propagation delays of the signal. At Sandia, we found these requirements forcing us to look at ASICs fabricated in GaAs.

46770 (UCID–20664-88) **Computer Science Research: Computation Directorate.** Durst, M.J. (ed.); Grupe, K.F. (ed.). Lawrence Livermore National Lab., CA (USA). 1988. 138p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015618/JAW. Available from NTIS, PC A07/MF A01 - OSTI; GPO Dep.

This report contains short papers in the following areas: large-scale scientific computation; parallel computing; general-purpose numerical algorithms; distributed operating systems and networks; knowledge-based systems; and technology information systems.

46771 (UCID–21740) **Programming in C at NMFECC [National Magnetic Fusion Energy Computing Center]: A practical guide.** Haney, S.W.; Crotinger, J.A. Lawrence Livermore National Lab., CA (USA). 26 Jul 1989. 46p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. Order Number DE89015185/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Despite its popularity elsewhere, C has not been extensively used for scientific programming on supercomputers. There are a number of reasons for this but perhaps the most compelling has been the lack of C compilers. However, this situation has recently begun to change at the National Magnetic Fusion Energy Computing Center (NMFECC) where two C development platforms — the Hybrid C Compiler (HCC) written at the Livermore Computer Center and the Portable C Compiler (CC version 4.1) distributed by Cray Research, Inc. (CRI) — have become available for use. These compilers produce object code for all of the Cray models at NMFECC and, in addition, possess good scalar optimization capabilities along with rudimentary vectorization capabilities. With the advent of the Cray C compilers, it is possible to consider physics code development in C at NMFECC. However, when one actually attempts to pursue this goal, one is quickly faced with a number of practical problems. For instance, How do I compile, link, and debug C codes? What special features of C are useful to me as a scientific programmer? Are there things I currently can't do in C programs? How do I interface my C program to existing Fortran code? Can I make use of the Basis code development system from C? Over the last three years we have incorporated C into numerous physics codes written at NMFECC and, in the course of this work, we have had to develop solutions to all of the above problems. This turned out to be a surprisingly frustrating and time-consuming venture requiring some rather subtle techniques and hacks. This guide is an attempt to document these techniques.

46772 (UCRL–53921-th) **An investigation of the usefulness of Earley's Algorithm in a general context-free recognizer.** Benedetti, C.M. Lawrence Livermore National Lab., CA (USA). Jun 1989. 95p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89016498/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

This thesis explores the potential applications of a general context-free recognizer implemented using Earley's Algorithm. First, several potential applications are identified. The recognizer is implemented, and tested using several grammars and input strings representative of these applications. The results of these tests are then examined to determine whether Earley's Algorithm can be successfully used in a general context-free recognizer. 19 refs., 8 figs., 18 tabs.

46773 (UCRL–100283) **Computing the two dimensional fast Fourier transform on a general purpose mesh connected multiprocessor.** Johansson, E.M.; De Groot, A.J.; Parker, S.R. Lawrence Livermore National Lab., CA (USA). 1989. 11p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8908130–1: SPIE conference on real-time signal processing XII, 10-11 Aug 1989). Order Number DE89016515/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This paper discusses an implementation of the two dimensional fast Fourier transform (FFT) on SPRINT, the Systolic Processor with a Reconfigurable Interconnection Network of Transputers. SPRINT is a 64 element multiprocessor developed at Lawrence Livermore National Laboratory for the experimental evaluation of systolic algorithms and architectures. The implementation is a radix two decimation in time algorithm, valid for an arbitrary sized $p \times q$ mesh of processors and an arbitrary sized $P \times Q$ complex input array (P, Q, p, and q must all be powers of two). The processors are interconnected with their nearest neighbors along North-South-East-West communication links. The problems of array partitioning, bit reversal, sub-array transform computation, and weighed (butterfly) combinations are all discussed. Finally, benchmark results are presented, and speedup and efficiency are discussed. 3 refs., 5 figs.

46774 (UCRL–100958) **Addressing user display requirements from a large and diverse user community.** Hunter, C.L.; Shultz, E.E. Jr. Lawrence Livermore National Lab., CA (USA). 19 Apr 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-8909126–1: 3. international conference on human computer interaction, 18-22 Sep 1989). Order Number DE89011403/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper describes a systematic, widely applicable methodology for defining user requirements for system functionality and user interface capabilities. This methodology is a variation of the user centered system design approach, which focuses on the user of a system. Our methodology involves obtaining user input from questionnaires and interviews, utilizing a range of statistical techniques to analyze user data, then developing mathematical models to define user needs. This methodology was used successfully to define user requirements in a replacement for an absolute system at Lawrence Livermore National Laboratory. Advantages and disadvantages of this methodology are discussed. 6 refs., 1 fig., 3 tabs.

46775 (UCRL–101208) **Methods and software for differential-algebraic systems.** Petzold, L.R. Lawrence Livermore National Lab., CA (USA). Jun 1989. 19p. Sponsored by U.S. DOE Energy Research. DOE Contract W-7405-ENG-48. (CONF-8908105–1: North Atlantic Treaty Organization advanced research workshop in real-time integration methods for mechanical system simulation, 8-11 Aug 1989). Order Number DE89015118/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

In recent years there has been a great deal of progress in the development of numerical methods and software for the solution of initial value problems in differential-algebraic equations (DAE's). In this paper we review the current state of the development and analysis of numerical methods such as multistep and implicit Runge-Kutta applied to classes of DAE's occurring in applications. We describe some of the available software, giving in particular details on the implementation and use of DASSL and its extensions. 37 refs.

46776 (UCRL–101256) **An overview of ASSESS-analytic system and software for evaluating safeguards and security.** Al-Ayat, R.A.; Cousins, T.C.; Matter, J.C. Lawrence Livermore National Lab., CA (USA). 26 Jun 1989. 9p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. (CONF-890736–63: 30. annual meeting of the Institute of Nuclear Materials Management, 9-12 Jul 1989). Order Number DE89016523/JAW. Available from NTIS, PC A02/MF A01 - OSTI; GPO Dep.

This paper provides an overview of ASSESS, a comprehensive approach for evaluating the effectiveness of facility safeguards against a spectrum of threats: insiders, outsiders, and hand-off collusion between insider and outsider adversaries. ASSESS version

1.0, completed in March 1989, contains significant new capabilities not present in the models currently used at DOE sites: ET and SAVI. The Insider module uses a reference database of defeat methods, strategies, and detection probabilities to determine the optimal theft scenario and Probability of Detection for each insider adversary type. The Outsider module calculates Probabilities of Interruption and identifies most vulnerable paths for a threat spectrum of: terrorists, criminals, psychotics, and extremists. A Neutralization module calculates the Probability of Neutralization of violent adversaries in a small force engagement for up to 30 combatants per side and 10 events. A Hand-off Collusion module calculates probabilities of System Win against hand-off of theft material by various insiders in collusion with outsiders. This paper describes the scope of, and the relationship between, each of the six modules–Manager, Facility, Insider, Outsider, Neutralization, and Hand-off Collusion-in the integrated ASSESS package developed jointly by Lawrence Livermore National Laboratory and Sandia National Laboratories for the US department of Energy's Office of Safeguards and Security. 11 refs., 9 figs.

9903 Information Handling

Refer also to citation(s) 44824, 45035, 45060, 45171, 46062, 46063, 46066, 46067, 46202, 46361, 46362

46777 (INDC(NDS)–219/LNA) **Report of the Nuclear Data Section to the International Nuclear Data Committee, September 1987 to February 1989.** Lorenz, A. (ed.). International Atomic Energy Agency, Vienna (Austria). International Nuclear Data Committee. May 1989. 39p. Order Number DE89636509/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

This progress report of the IAEA Nuclear Data Section covers the 18-months period September 1987 to February 1989. It describes past, current and planned activities of the Section and presents the status of its nuclear data centre services and technology transfer. (author). 2 figs, 2 tabs.

46778 (PNL–6925) **Testing systems database specification.** Caplinger, J.T.; Corrigan, A.L.; Olander, M. Pacific Northwest Lab., Richland, WA (USA). May 1989. 114p. Sponsored by U.S. Department of Defense. DOE Contract AC06-76RL01830. (TD–2699). Order Number DE89016245/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

The Pacific Northwest Laboratory (PNL) has been contracted by the Navy Personnel Research and Development Center (NPRDC) to provide software for enhancing the NPRDC CAMP Facility. The objectives of this Database Specification are to provide the Database Administrator, maintenance programmers, and users with the following: a reference to the database design and data tables in the database, a description of the data flow when loaded into the database, a list of storage requirements for the database and support programs, and a discussion of the security issues involved. This paper describes the database: its name, physical system, availability, storage requirements, organization, data loading logic, data modification, support programs, and security. Also defined are the data tables and elements that compose the TSD.

46779 (PNL–6926) **Testing Systems Database Interface operation manual.** Caplinger, J.T.; Olander, M. Pacific Northwest Lab., Richland, WA (USA). May 1989. 77p. Sponsored by U.S. Department of Defense. DOE Contract AC06-76RL01830. (TD–2699). Order Number DE89016243/JAW. Available from NTIS, PC A05/MF A01 - OSTI; GPO Dep.

A joint-service effort is under way to develop, evaluate, and field-test a Computerized Adaptive Testing version of the Armed Services Vocational Aptitude Battery (CAT-ASVAB). The CAT-ASVAB is being evaluated as a replacement for the Paper and Pencil ASVAB (P&P-ASVAB), which is currently used for military personnel selection and classification. During the Score Equating Development (SED) phase of the evaluation, the CAT-ASVAB is being administered at a limited number of Military Entrance Processing Stations (MEPS). At these stations all examinees are given an operational P&P-ASVAB; in addition, approximately one-third are given a nonoperational P&P-ASVAB and two-thirds are given the CAT-ASVAB. Data are being transmitted from the MEPS to the Navy Personnel Research and Development Center (NPRDC) for analysis and storage in the Testing Systems Database. The Testing Systems Database (TSD) and its supporting programs reside on a minicomputer at the NPRDC's CAT-ASVAB Maintenance and Psychometric (CAMP) Facility in San Diego, California. The CAMP Facility supports the development, maintenance, and continuing improvement of the CAT-ASVAB testing program. The purpose of this Interface Operation Manual is to provide operating instructions for the TSD "Interface," a system of menus and interactive screen displays that integrate the use of the TSD and its supporting programs. It is not the purpose of this manual to document in detail the general use of commercial or NPRDC-produced programs that are documented elsewhere. 34 figs.

46780 (PNL–6927) **Testing systems database interface users manual.** Olander, M. Pacific Northwest Lab., Richland, WA (USA). May 1989. 29p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC06-76RL01830. (TD–2699). Order Number DE89016240/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

A joint-service effort is under way to develop, evaluate, and field-test a Computerized Adaptive Testing version of the Armed Services Vocational Aptitude Battery (CAT-ASVAB). The CAT-ASVAB is being evaluated as a replacement for the Paper and Pencil ASVAB (P& P-ASVAB), which is currently used for military personnel selection and classification. During the Score Equating Development (SED) phase of the evaluation, the CAT-ASVAB is being administered at a limited number of Military Entrance Processing Stations (MEPS). At these stations all examinees are given a P&P operational ASVAB; in addition, approximately one-third are given a P&P non-operational ASVAB and two-thirds are given the CAT-ASVAB. Data are being transmitted from the MEPS to the CAT-ASVAB Maintenance and Psychometric (CAMP) Facility for analysis and storage. The CAMP Facility supports the development, maintenance, and continuing improvement of the CAT-ASVAB testing program. The Pacific Northwest Laboratory (PNL) was contracted by the Navy Personnel and Development Center (NPRDC) to provide software for enhancing the NPRDC CAMP facility. The objective of this Users Manual is to provide an overview of the Testing Systems Database (TSD) Interface, which is designed to support the transfer, quality assurance, analysis, and maintenance of data pertaining to the evaluation of the CAT-ASVAB. This document provides the general management and personnel who are not automated data processing staff with the information necessary to understand the system.

46781 (SAND–89-1502) **Performance reports for EIM [Engineering Information Management] computer systems: A managerial perspective.** Wenderlich, N.D.; Reid, R.A. Sandia National Labs., Albuquerque, NM (USA). Jul 1989. 36p. Sponsored by U.S. DOE Management & Administration. DOE Contract AC04-76DP00789. Order Number DE89015194/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

This document describes twelve different kinds of charts which have been designed to help manage the performance of the Engineering Information Management (EIM) computer systems at Sandia National Laboratories Albuquerque. Operational data generated by the two major software systems, Multiple Virtual Storage (MVS) and Integrated Database Management System (IDMS), are summarized to visually portray actual service levels and meaningful system performance characteristics. To demonstrate the potential utility of the resulting performance reports, summarized data in illustrative charts are evaluated from a managerial point of view. The resulting graphs can stimulate relevant analyses for modeling the impact of forecasted workloads on system service level objectives and identifying problems or trends that need the attention of system tuners. 15 figs.

9904 Law

Refer also to citation(s) 45135

46782 (INFO–0055(Rev.1)) **Safety objectives for nuclear activities in Canada.** Atomic Energy Control Board, Ottawa, ON (Canada). Apr 1982. 18p. (In English, French). (ACNS–2). Order Number DE89635654/JAW. Available from NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS.

French version included.

This report by the Advisory Committee on Nuclear Safety presents a concise statement of the basic safety objectives which the Committee considers underlie, or should underlie, the regulations and the licensing and compliance practices of the Atomic Energy Control Board. The report also includes a number of general criteria for achieving these objectives.

9905 Civilian Defense

46783 (AD-A–207654/5/XAB) **Ground-based radar (GBR): environmental assessment. Final report.** Army Strategic Defense Command, Huntsville, AL (USA). Mar 1989. 131p. Available from NTIS, PC A07/MF A01.

The President's Strategic Defense Initiative (SDI), announced on March 23, 1983, initiated an extensive research program to determine the feasibility of developing an effective ballistic missile defense system. The technological progress made on the SDI research program since 1983 has advanced at an unexpectedly fast pace and is still accelerating. Recognizing that no strategic defense system could be deployed all at once, the Strategic Defense Initiative Organization is using an evolutionary approach to strategic concept addressing the question of how to deploy or deploy. In September 1987, some technologies were advanced from the Concept Exploration phase of the material acquisition process to the Concept Demonstration and Validation phase under this approach, because they were judged to be mature enough in concept definition to warrant further evaluation.

46784 (AD-A–207806/1/XAB) **Annual report to the Strategic Defense Initiative organization on the free-electron laser driven by the NIST c-w microtron. Annual report, 1 April 1988-31 March 1989.** Johnson, R.G. National Inst. of Standards and Technology, Gaithersburg, MD (USA). 5 May 1986. 101p. Available from NTIS, PC A06/MF A01.

Excellent progress was made during the reporting year on all areas critical to the NIST-NRL FEL project. A contract for the construction of a wiggler was signed early in this reporting period. The contractor has completed the engineering design of the wiggler and is well along in construction. Several methods to increase the peak current in the RTM were studied. The conceptual design of the injector for the method selected was completed. A study on the problem of mirror damage was completed, and commercial suppliers of mirrors that can withstand the high-intracavity power of the FEL were identified. The design of the room in which the FEL is located has been improved, and the design of the users area has been completed. Calculations of FEL performance have been extended to include short-pulse effects and the effects of wiggler magnetic field errors. A major activity in this period has been preparation of the RTM for one-pass acceleration to 17 MeV. One-pass tests were started, and preliminary measurements of beam quality were better than design goals by a factor of two.

46785 (AD-A–208033/1/XAB) **Comparison and analysis of strategic-defense-transition stability models. Final report.** Oelrich, I.; Bracken, J. Institute for Defense Analyses, Alexandria, VA (USA). Dec 1988. 102p. (IDA-P–2145). Available from NTIS, PC A06/MF A01.

This paper discusses the nature and causes of strategic stability and instability, how defenses affect the stability equation, problems of partial defenses and various attempts to model stability during the transition to effective defense. All of the models reviewed demonstrate that there is some stable path from no defenses to near perfect (99% effective) defenses, and the paper presents an integrated theory that shows the common nature of all of the stable paths. This paper demonstrates that the results of the various transition stability models differ not in numerical results but in the measures of stability used. Recommendations for future transition stability studies are included, based on the review of the various models. The appendices contain detailed descriptions of models used in the various transition stability studies reviewed.

46786 (AD-A–208034/9/XAB) **Strategic Defense System distributed operating system R & D (research and development) review and recommendations. Final report.** Gordon, K.D.; Linn, C.J. Institute for Defense Analyses, Alexandria, VA (USA). Apr 1989. 66p. (IDA-P–2142). Available from NTIS, PC A04/MF A01.

The Strategic Defense System (SDS) imposes a set of requirements on distributed operating systems that is not met by state-of-the-art systems. In this paper, the key requirements are identified as being real-time support, reliability/fault tolerance, and security. The extent to which these requirements are being addressed by current distributed operating system research is discussed. The three distributed operating system projects that are currently receiving SDIO funds - Alpha, Cronus, and Mach - are reviewed. A fourth project, the V-distributed system project of Stanford University, is also highlighted, because of its unique potential for meeting certain SDS needs. Recommendations on the directions in which the SDIO should pursue each of these projects are made. The Office of Naval Research (ONR) Real-Time Computing Initiative, which is addressing some issues critical to the development of the SDS, is described. It is recommended that the SDIO seek to coordinate with the ONR in this effort. The appendix to this paper provides detailed descriptions of the Alpha, Cronus, Mach, and V-distributed operating system projects, as well as three other projects noted in the body of the paper: Amoeba, Clouds, and the Heterogeneous Computer Systems (HCS) Project.

46787 (ORNL/TM–10995) **Recent ORNL [Oak Ridge National Laboratory] improvements to the HULL hydrocode system.** Burns, T.J. Oak Ridge National Lab., TN (USA). May 1989. 41p. Sponsored by U.S. DOE Defense Programs. DOE Contract AC05-84OR21400. Order Number DE89015649/JAW. Available from NTIS, PC A03/MF A01 - OSTI; GPO Dep.

Modifications to the HULL hydrocode system are described. The modifications concern the problem generator of the system, KEEL. Revised algorithms for implementing combinatorial geometry, defining reference geometries, material "packaging," and restarting two- and three-dimensional calculations are described. The user input necessary to exercise the added/improved features is outlined and examples illustrating the revised capabilities are provided. 1 ref., 7 figs.

46788 (PB–89-209357/XAB) **Assessment of space-power-related measurement requirements of the Strategic Defense Initiative. Technical note (Final).** Olthoff, J.K.; Hebner, R.E. National Inst. of Standards and Technology, Gaithersburg, MD (USA). Apr 1989. 147p. (NIST/TN–1259). Available from NTIS, PC A07/MF A01.

Also available from Supt. of Docs. as SN003-003-02930-1.

A survey was performed to determine the measurement requirements of space-power-related parameters for anticipated SDI systems. These requirements were compared to present state-of-the-art metrology capabilities as represented by the calibration capabilities of the National Institute of Standards and Technology. Metrology areas where present state-of-the-art capabilities are inadequate to meet SDI requirements are discussed, and areas of metrology-related research that appear promising to meet these needs are examined. Particular attention is paid to the difficulties of long-term, unattended sensor calibrations and long-term measurement reliability.

46789 (UCID–21736) **XRLSim model specifications and user interfaces.** Ng, L.C.; Gavel, D.T.; Shectman, R.M.; Sholl, P.L.; Woodruff, J.P. Lawrence Livermore National Lab., CA (USA). Apr 1989. 92p. Sponsored by U.S. DOE Defense Programs. DOE Contract W-7405-ENG-48. Order Number DE89015183/JAW. Available from NTIS, PC A06/MF A01 - OSTI; GPO Dep.

This report summarizes our FY88 engineering development effort of XRLSim — an Ada-based computer program developed to provide a realistic simulation of an x-ray laser weapon platform. XRLSim can be used to assess platform requirements in track handoff, target acquisition, tracking, and pointing as well as engagement time line. Development effort continues in FY89 to enhance the model fidelity of the platform and to improve the performance of the tracking algorithms. Simulated targets available in XRLSim include midcourse reentry vehicles and orbiting satellites. At this time, the current version of XRLSim can only simulate a one-on-one engagement scenario. 8 refs., 26 figs.

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AC07-76ID01570	**Argonne National Lab., IL (USA)**	
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	Geological Survey, Idaho Falls, ID (USA)	
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	Babcock and Wilcox Co., Lynchburg, VA (USA). Contract Research Div.	
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	EG and G Idaho, Inc., Idaho Falls, ID (USA)	
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	EG and G Energy Measurements, Inc., Albuquerque, NM (USA). Kirtland Operations	
	14:46352	EGG-10617-6065
AC08-89NV10630	**Nevada Univ., Las Vegas, NV (USA)**	
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FG05-80ET53088	Texas Univ., Austin, TX (USA). Dept. of Physics	
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FG22-87BC14126	University of Southern California, Los Angeles, CA (USA). Dept. of Petroleum Engineering	
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02681	14:44465	*See* OPI–1989			
02686	14:45173	*See* CANWEC–1989			
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02759	14:44914	*See* TU/CEA–G-288			
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02769	14:44893	*See* GML–75PE1135			
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CONF-8510301–		(35. Canadian Chemical Engineering conference: leading edges of technology; 6-9 Oct 1985)			
	14:44673	*See* AECL–8403			
CONF-8510513–		(2. northern European drilling conference; 21-23 Oct 1985)			
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CONF-8603264–		(Experiences and new developments in well completion; 17-19 Mar 1986)			
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CONF-8603265–		(Practical aspects of modeling in exploration and development; 3-5 Mar 1986)			
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CONF-860417–		(3. international symposium/workshop on irradiated fuel storage; 8-10 Apr 1986)			
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CONF-8606428–		(Canadian Nuclear Association international nuclear conference; 8-11 Jun 1986)			
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CONF-8606429–		(Joint discussion meeting of the Johannes Gutenberg University, the Max Planck Institute, and the local government of Mainz; 13 Jun 1986)			
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CONF-8609350–		(2. international conference on nuclear waste management; Sep 1986)			
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	14:46181	*See* AECL–9345			
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	14:44527	*See* NEI-NO–69			
CONF-861026–		(Topical meeting on CANDU fuel; 6-8 Oct 1986)			
	14:45046	*See* AECL–9326			
	14:45047	*See* AECL–9329			
	14:45048	*See* AECL–9330			
CONF-861035–		(2. international meeting on simulation methods in nuclear engineering; 14-16 Oct 1986)			
	14:45109	*See* AECL–8762			
CONF-870279–		(Lake Louise winter institute meeting; 15-21 Feb 1987)			
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CONF-8703324–		(Reservoir management in field development and production; 30-31 Mar 1987)			
	14:44491	*See* NEI-NO–70			

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CONF-8705187–		(37. Canadian chemical engineering conference (Canadian engineering centennial convention); 18-22 May 1987)			
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CONF-8706402–		(ASCE special conference nearshore hydrodynamics; Jun 1987)			
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CONF-8707208–		(U.S. Particle Accelerator School: physics of particle accelerators; 20 Jul - 14 aug 1987)			
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CONF-8709462–		(Technical committee meeting on uranium resources and geology of North America; 1-3 Sep 1987)			
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CONF-8709463–		(Food processing waste conference; 1 Sep 1987)			
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CONF-870970–		(5. international conference on nuclei far from stability; 14-19 Sep 1987)			
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CONF-8710473–		(Seminar on third party financing for energy savings; 8-9 Oct 1987)			
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CONF-8710491–		(Consultants' meeting on the need for intercomparison and reference materials for characterization of silicon; 2-3 Oct 1987)			
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CONF-871062–		(Windpower '87; 5-8 Oct 1987)			
15	14:44975	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89910941/JAW	MF-000
CONF-871101–		(Joint meeting of the American Nuclear Society and the Atomic Industrial Forum; 15-19 Nov 1987)			
	14:45107				
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	14:46054				
CONF-8711314–		(Seminar on the application of nuclear techniques in industry; 17 Nov 1987)			
	14:46212	*See* INIS-mf–11479			
CONF-8711319–		(10. lecture meeting on long-term behaviour of heat-resistant steels and high-temperature materials; 27 Nov 1987)			
	14:45473	*See* INIS-mf–11952			
CONF-8711322–		(Environmetrics '87; 15-18 Nov 1987)			
1	14:46070	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016894/JAW	MF-101
CONF-8711323–		(Wood-fired boiler workshop; 24-25 Nov 1987)			
	14:44860	*See* CNBA–8711			
CONF-8712146–		(Experts' meeting; 3-4 Dec 1987)			
	14:45117	*See* EUR–11755			
CONF-8801163–		(International energy agency workshop on separation technologies; 25-28 Jan 1988)			
	14:45420	*See* PNL-SA–17216			
CONF-8801168–		(DLG winter meeting; 12-13 Jan 1988)			
1	14:46324	*See* DLG–538031			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8803232–		(IIASA/NILU Task Force meeting on accuracy of emmission inventories; 8-10 Mar 1988)			
1	14:46080	*See* NILU-F–6/88			
CONF-8804292–		(Seminar on natural environmental change: processes affecting the deep disposal of radioactive waste in Britain; 21 Apr 1988)			
	14:44711	*See* DOE-RW–89.029			
CONF-8804297–		(2. research co-ordination meeting on nuclear techniques for toxic elements in foodstuffs; 19-22 Apr 1988)			
	14:45599	*See* INIS-mf–11504			
CONF-880505–		(3. topical meeting on tritium technology in fission, fusion and isotopic applications; 1-6 May 1988)			
	14:46731				
CONF-880518–		(International conference on research in thermochemical biomass conversion; 2-6 May 1988)			
6	14:44900	*See* PNL-SA–15701			
CONF-8805285–		(8. international conference on plasma surface interactions in controlled fusion devices (PSI-8); 2-6 May 1988)			
	14:46616				
	14:46692				
	14:46693				
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	14:46730				
CONF-8805321–		(Workshop on rotordynamic instability problems in high-performance turbomachinery; 16-18 May 1988)			
	14:45763	*See* N–89-22891			
CONF-880606–		(10. symposium on thermophysical properties; 20-23 Jun 1988)			
	14:45576				
	14:45702				
	14:45855				
	14:46025				
CONF-8806231–		(International Atomic Energy Agency (IAEA) advisory group meeting on atomic and molecular data for radiotherapy; 13-16 Jun 1988)			
	14:46240	*See* IAEA-TECDOC–506			
CONF-8806235–		(International conference on advanced technology and particle physics; 12-17 Jun 1988)			
	14:46008				
CONF-8806237–		(DOE/CEC workshop; 22-24 Jun 1988)			
	14:46284	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015214/JAW	MF-408
CONF-880631–		(29. annual meeting of the Institute of Nuclear Materials Management; 26-29 Jun 1988)			
61	14:44825	*See* WHC-SA–0337			
CONF-8806390–		(Scaling, fractals and non-linear variability in geophysic; 27 Jun - 1 jul 1988)			
1	14:46058	*See* CEA-CONF–9764			
CONF-8806400–		(Japan-U.S. workshop P-119 on 14 MeV neutron source for material R and D based on plasma devices; 7-10 Jun 1988)			
	14:46714	*See* IPPJ-T–37			
CONF-8806404–		(Seminar on efficient use of solar energy in solar heated swimming pools; 9 Jun 1988)			
	14:44888	NTIS (US Sales Only), PC A04/MF A01		DE89914827/JAW	MF-000
CONF-880679–		(81. annual meeting of Air Pollution Control Association; 19-24 Jun 1988)			
13	14:45363	*See* LBL–24965			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-880680–		(Prevention of significant nuclear events conference; 6-9 Jun 1988)			
2	14:44670	*See* WHC-SA–0352			
CONF-8807181–		(10. EPRI radwaste workshop; 18-20 Jul 1988)			
	14:44723	*See* EPRI-NP–6453			
CONF-8808224–		(ONRL workshop on engineering materials for very high temperatures; 29 Aug 1988)			
	14:45536	*See* ONRL–8-016-R			
CONF-880904–		(4. topical meeting on short wavelength coherent radiation: generation and applications; 26-29 Sep 1988)			
11	14:45784	*See* BNL–42393			
CONF-8809223–		(Workshop on new directions in neutrino physics; 14-16 Sep 1988)			
8	14:46445	*See* BNL–42957			
CONF-8809227–		(American Chemical Society Division of Petroleum Chemistry; 25-30 Sep 1988)			
	14:44623				
	14:45704				
CONF-8809265–		(Chemistry of carbonization of petroleum feedstocks; 25-30 Sep 1988)			
	14:44442				
CONF-8809266–		(Direct conversion of methane to higher homologues; 25-30 Sep 1988)			
	14:45703				
CONF-8809383–		(National workshop on the use of ^{137}Cs to measure erosion; 20 Sep 1988)			
	14:46124	*See* INIS-mf–11490			
CONF-8809384–		(ACS meeting on advances in zeolite synthesis; 25-30 Sep 1988)			
1	14:45693	*See* LBL–26513			
CONF-880965–		(20. IEEE photovoltaic specialists conference; 26-30 Sep 1988)			
	14:44896	*See* N–89-22177			
CONF-881011–		(Joint meeting of the European Nuclear Society and the American Nuclear Society; 30 Oct - 4 nov 1988)			
	14:44669				
	14:44777				
	14:44778				
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	14:45032				
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	14:45059				
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	14:45158				
	14:45159				
	14:45160				
CONF-8810134–		(Symposium on radon and radon reduction technology; 17-21 Oct 1988)			
7	14:45365	*See* LBL–27362			
CONF-8810155–		(16. water reactor safety information meeting; 24-27 Oct 1988)			
49	14:45021	*See* EGG-M–88311			
CONF-8810182–		(International collaboration on advanced neutron sources (ICANS); 3-7 Oct 1988)			
32	14:44830	*See* LA-UR–89-2920			
CONF-8810402–		(Meeting on clay microstructure; 4 Oct 1988)			
1	14:44703	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015906/JAW	MF-800
CONF-8810409–		(10. Autumn School on physics beyond the standard model; 10-14 Oct 1988)			
1	14:46487	*See* BNL–42855			
CONF-8810413–		(5. All-Union conference on spectroscopy of coordination compounds; 5 Oct 1988)			
	14:45640	*See* INIS-SU–107/A			
CONF-8810416–		(5. seminar on software development in nuclear energy research; 17-18 Oct 1988)			
	14:46759	*See* JAERI-M–89-012			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8810419–		(Topic seminar HVAC '88; 6 Oct 1988)			
	14:45199	*See* STF–15A88037			
CONF-8810421–		(Wood energy symposium; 25-26 Oct 1988)			
	14:44864	*See* NBNRE–8810			
CONF-8811171–		(17. INS international symposium on nuclear physics at intermediate energies; 15-17 Nov 1988)			
4	14:46437	*See* LA-UR–89-2756			
CONF-8811238–		(11. Canadian national energy forum; 21-22 Nov 1988)			
	14:45173	*See* CANWEC–1989			
CONF-8811251–		(7. All-Union conference on crystal growth; 14 Nov 1988)			
	14:45451	*See* INIS-SU–111/A			
CONF-8811253–		(ASTM symposium on evaluation and techniques in fractography; 10 Nov 1988)			
1	14:45457	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015361/JAW	MF-000
CONF-881131–		(Society for Reactor Safety meeting on research to increase the safety of nuclear power plants; 3-4 Nov 1988)			
	14:45126	*See* GRS–69			
	14:45169	*See* INIS-mf–11983			
CONF-881143–		(American Institute of Chemical Engineers annual meeting; 27 Nov - 2 dec 1988)			
	14:44895	*See* N–89-16917			
CONF-8812104–		(VDEW press symposium on energy policy; 7 Dec 1988)			
	14:44725	*See* INIS-mf–11996			
CONF-8812106–		(2. National Meeting of Thermal Science; 6-8 Dec 1988)			
	14:45040	*See* INIS-BR–1575			
	14:45051	*See* INIS-BR–1576			
	14:45052	*See* INIS-BR–1577			
	14:45844	*See* INIS-BR–1578			
	14:45845	*See* INIS-BR–1579			
	14:45846	*See* INIS-BR–1580			
	14:45847	*See* INIS-BR–1581			
	14:46713	*See* INIS-BR–1623			
CONF-881296–		(Workshop on research and development opportunities in supercritical fluid technology; 2 Dec 1988)			
Summ.	14:45400	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015320/JAW	PC-310;STD-310
CONF-8901135–		(Institute of the Union of Radio Science scientist and engineers student contest; 3-7 Jan 1989)			
1	14:46660	*See* SAND–89-7101C			
CONF-8901153–		(Ceramics-metal interfaces conference; 16-18 Jan 1989)			
1	14:46020	*See* LBL–26734			
CONF-890160–		(4. annual battery conference on applications and advances; 17-19 Jan 1989)			
	14:45164	*See* N–89-22710			
CONF-890199–		(8. Moriond workshop on tests of fundamental laws in physics; 21-28 Jan 1989)			
	14:46402	*See* GSI–89-49(prepr.)			
CONF-890211–		(4. international photovoltaic science and engineering conference; 14-17 Feb 1989)			
	14:44897	*See* N–89-22651			
CONF-8902118–		(International Energy Agency workshop on fusion materials irradiation facilities; 14-17 Feb 1989)			
2	14:46716	*See* LA-UR–89-2489			
CONF-8902122–		(Results and perspectives in particle physics; 26 Feb - 4 mar 1989)			
3	14:46435	*See* FNAL/C–89/148-E			
CONF-890270–		(International industrial symposium on the super collider; 8-10 Feb 1989)			
22	14:45956	*See* FNAL-TM–1595			
CONF-8903103–		(International symposium on magnetoelasticity and electronic structure of transition metals, alloys, and films; 20-22 Mar 1989)			
2	14:45458	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016868/JAW	MF-404

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-8903130–		(Strings '89 conference; 13-18 Mar 1989)			
2	14:46489	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016582/JAW	MF-413
3	14:46505	*See* SLAC-PUB–5022			
CONF-8903158–		(Inaugural symposium for Center for Science and Technology; 2 Mar 1989)			
1	14:46757	*See* DOE/ER/25009–806			
CONF-8903159–		(Whither turbulence conference; 22-24 Mar 1989)			
1	14:46422	*See* UCRL–101562			
CONF-890318–		(Joint symposium on stationary combustion nitrogen oxide control; 6-9 Mar 1989)			
Vol.1	14:44998	*See* EPRI-GS–6423-Vol.1			
CONF-890335–		(13. particle accelerator conference; 20-23 Mar 1989)			
250	14:45935	*See* SLAC-PUB–4920			
CONF-890352–		(US Department of Energy research and development for the geothermal marketplace: 7th geothermal program review; 21-23 Mar 1989)			
10	14:44947	*See* EGG-M–89081			
CONF-890408–		(Advances in nuclear engineering computation and radiation shielding; 9-13 Apr 1989)			
16	14:44833	*See* WHC-SA–0385			
CONF-8904107–		(2. international conference on high-density pinches (ICHDP-2); 26-28 Apr 1989)			
8	14:46717	*See* LA-UR–89-2782			
CONF-8904122–		(5. international power transmission and gearing conference; 25 Apr 1989)			
	14:45764	*See* N–89-22919			
CONF-8904169–		(Symposium on the fundamentals of gasification; 9-14 Apr 1989)			
	14:44441				
CONF-8904196–		(2. space electrochemical research and technology conference; 11-13 Apr 1989)			
	14:45163	*See* N–89-22982			
CONF-8904226–		(12. international workshop on weak interactions and neutrinos; 9-14 Apr 1989)			
7	14:46439	*See* SLAC-PUB–4997			
CONF-8904230–		(AVS topical conference on surface conditioning of vacuum systems; 3-7 Apr 1989)			
4	14:46722	*See* PPPL–2642			
CONF-8904258–		(17. NASTRAN users' colloquium; 24-28 Apr 1989)			
	14:45765	*See* N–89-22940			
CONF-8904259–		(American Society for Precision Engineering spring conference; 25-27 Apr 1989)			
1	14:45572	*See* UCRL–100647			
CONF-890426–		(Spring meeting of the Materials Research Society; 24-28 Apr 1989)			
25	14:45490	*See* LBL–27498			
26	14:45489	*See* LBL–27356			
27	14:46573	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016224/JAW	MF-404
28	14:45455	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015970/JAW	MF-404
CONF-8904260–		(International conference on planning for agroforestry; 24 Apr 1989)			
1	14:44901	*See* PNL-SA–17268			
CONF-8904261–		(National Council on Radiation Protection and Measurements (NCRP) annual meeting; 5 Apr 1989)			
1	14:46285	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015969/JAW	MF-408
CONF-8904263–		(American Physical Society spring conference; 24-27 Apr 1989)			
1	14:45573	*See* UCRL–100650			
CONF-8904264–		(Symposium on the seismicity, seismotectonic and seismic risk of the Ibero-Maghrebian region; 12-14 Apr 1989)			
	14:46351	*See* CEA-DAS–602			
CONF-8904267–		(Symposium on particle identification at high luminosity hadron colliders; 5-7 Apr 1989)			
2	14:46003	*See* SLAC-PUB–5002			
CONF-890488–		(4. international symposium on ceramics in nuclear waste management; 23-27 Apr 1989)			
10	14:44774	*See* WHC-SA–0598			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CONF-890491–		(International conference on fifty years of research in nuclear fission; 3-7 Apr 1989)			
8	14:46545	*See* DOE/ER/40048–225-L9			
CONF-8905126–		(Workshop on cold fusion phenomena; 23-25 May 1989)			
4	14:46662	*See* EGG-M–89203			
CONF-8905143–		(NATO international advanced course on the nuclear equation of state; 12 May - 3 jun 1989)			
3	14:46488	*See* BNL–42968			
10	14:45916	*See* LBL–27496			
11	14:46630	*See* UCRL–101545			
12	14:46426	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016583/JAW	MF-414
13	14:46438	*See* LA-UR–89-2960			
CONF-8905144–		(Tau-Charm workshop; 23-27 May 1989)			
5	14:46442	*See* SLAC-PUB–5046			
6	14:45977	*See* SLAC-PUB–5038			
7	14:46479	*See* SLAC-PUB–5030			
8	14:46441	*See* SLAC-PUB–5005			
9	14:46440	*See* SLAC-PUB–5004			
10	14:46005	*See* SLAC-PUB–5040			
11	14:46481	*See* SLAC-PUB–5083			
12	14:46443	*See* SLAC-PUB–5081			
CONF-8905156–		(International Centre for Theoretical Physics conference; 22-26 May 1989)			
2	14:45918	*See* ANL-HEP-CP–89-75			
3	14:46542	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016915/JAW	MF-413
CONF-8905166–		(American Society for Mass Spectroscopy annual symposium; 22-26 May 1989)			
8	14:45625	*See* PNL-SA–16651			
CONF-8905194–		(4. Pisa meeting on advanced detectors: frontier detectors from frontier physics; 21-26 May 1989)			
3	14:45989	*See* FNAL/C–89/155-E			
4	14:46004	*See* SLAC-PUB–5016			
5	14:46006	*See* SLAC-PUB–5042			
CONF-8905198–		(11. international conference on transport theory; 22-26 May 1989)			
1	14:46754	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016223/JAW	MF-000
CONF-8905199–		(State of Mississippi energy future symposium; 21-24 May 1989)			
1	14:44890	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016286/JAW	MF-249
CONF-890520–		(International conference: inside the sun; 22-26 May 1989)			
1	14:46376	*See* LA-UR–89-2825			
CONF-8905200–		(International Energy Agency's workshop on buildings of the 21st century; 16-18 May 1989)			
1	14:45364	*See* LBL–27213			
CONF-8905201–		(Conference on emergent computation; 22-26 May 1989)			
1	14:46196	*See* LA-UR–89-2456			
2	14:46197	*See* LA-UR–89-2618			
CONF-8905204–		(International flame research foundation; 24-26 May 1989)			
1	14:45875	*See* EGG-M–89123			
CONF-890579–		(European Materials Research Society spring meeting; 30 May - 2 jun 1989)			
1	14:45456	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016857/JAW	MF-404
CONF-890583–		(Symposium on the occasion of the 40th anniversary of the nuclear shell model; 25-27 May 1989)			
3	14:46539	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016914/JAW	MF-413
CONF-890604–		(Annual meeting of the American Nuclear Society; 4-8 Jun 1989)			
13	14:44806	*See* DOE/SSDP–0066			
14	14:44807	*See* DOE/SSDP–0068			
15	14:44808	*See* DOE/SSDP–0069			
CONF-8906134–		(24. AIAA thermophysics conference; 11-15 Jun 1989)			
	14:45762	*See* N–89-22850			
CONF-8906150–		(3. international conference on microcomputers in transportation; 21-23 Jun 1989)			
3	14:45392	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017260/JAW	MF-405

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CONF-8906155–		(Radiation effects in insulators-5: crystalline oxides and ceramics session; 19-23 Jun 1989)			
5	14:46580	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016843/JAW	MF-410
CONF-8906168–		(International conference on selected topics in nuclear structure; 20-24 Jun 1989)			
3	14:46566	*See* UCRL–101175			
CONF-8906185–		(Materials Research Society materials analysis workshop; 14-17 Jun 1989)			
4	14:46562	*See* LA-UR–89-2790			
CONF-8906195–		(Radon homes: dangerous or not?; 15 Jun 1989)			
1	14:46309	*See* LBL–27448			
CONF-8906197–		(10. university conference on glass science; 7-9 Jun 1989)			
1	14:46581	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016081/JAW	MF-406
CONF-8906198–		(Environmental databases workshop; 19 Jun 1989)			
1	14:46062	*See* LBL–27436			
CONF-8906199–		(9. international conference on physics in collision; 19-21 Jun 1989)			
1	14:46450	*See* DOE/ER/13065–587			
CONF-8906204–		(International symposium on heavy quark physics; 13-17 Jun 1989)			
1	14:46477	*See* SLAC-PUB–5018			
2	14:46480	*See* SLAC-PUB–5051			
CONF-890631–		(International symposium on packaging and transporting of radioactive materials; 11-16 Jun 1989)			
64	14:45757	*See* EGG-M–89154			
65	14:45755	*See* EGG-M–88372			
67	14:45756	*See* EGG-M–88373			
68	14:45754	*See* EGG-M–88370			
CONF-890660–		(Institute of Electrical and Electronics Engineers (IEEE) Antennas Propagation Society (AP-S) international symposium; 26-30 Jun 1989)			
9	14:45781	*See* UCRL–101190			
CONF-890703–		(International conference on ion sources; 9-15 Jul 1989)			
16	14:45961	*See* LBL–26824			
CONF-890708–		(16. international conference on the physics of electronic and atomic collisions; 26 Jul - 1 aug 1989)			
6	14:46574	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015983/JAW	MF-410
CONF-8907118–		(25. American Society of Mechanical Engineers joint propulsion conference; 10-13 Jul 1989)			
	14:45741	*See* N–89-22053			
CONF-8907120–		(NATO research workshop on self-trapping of vibrational energy in protein; 30 Jul - 4 aug 1989)			
1	14:45692	*See* LA-UR–89-2561			
CONF-8907121–		(2. international conference on vacuum microelectronics; 24-26 Jul 1989)			
1	14:45871	*See* UCRL–100525			
CONF-8907123–		(EPA waste testing and quality assurance symposium; 24-28 Jul 1989)			
1	14:46133	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015358/JAW	MF-000
CONF-8907126–		(38. annual x-ray conference; 31 Jul - 4 aug 1989)			
1	14:45484	*See* LA-UR–89-2459			
CONF-8907127–		(12. few body conference; 2-8 Jul 1989)			
1	14:46515	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016391/JAW	MF-414
2	14:46561	*See* LA-UR–89-2505			
CONF-8907129–		(NATO advanced research workshop on physics and geometry; 2-8 Jul 1989)			
1	14:46491	*See* FNAL/C–89/164-T			
2	14:46506	*See* UCRL–101586			
CONF-8907130–		(9. vacuum ultraviolet radiation conference; 17-21 Jul 1989)			
1	14:45725	*See* LA-UR–89-2337			
CONF-8907131–		(4. international conference on N-substituted aryl compounds: occurrence, metabolism and biological impact of nitroarenes; 15-19 Jul 1989)			
1	14:46200	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015985/JAW	MF-408
CONF-8907134–		(17. SLAC summer institute: physics at the 100 GeV mass scale; 10-21 Jul 1989)			
1	14:46452	*See* FNAL/C–89/168-T			

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CONF-8907136–		(NATO advanced research workshop on radiative corrections: results and perspectives; 9-14 Jul 1989)			
1	14:46478	*See* SLAC-PUB–5025			
CONF-890718–		(International conference on materials and mechanisms of superconductivity - high-temperature superconductors; 23-28 Jul 1989)			
25	14:45522	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016905/JAW	MF-404
CONF-890721–		(Joint ASME/JSME pressure vessel and piping conference; 23-27 Jul 1989)			
41	14:45856	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016904/JAW	MF-113
CONF-890736–		(30. annual meeting of the Institute of Nuclear Materials Management; 9-12 Jul 1989)			
58	14:44664	*See* LA-UR–89-2178			
59	14:44821	*See* UCRL–101252			
60	14:44822	*See* UCRL–101425			
61	14:44823	*See* UCRL–101426			
62	14:44824	*See* UCRL–101570			
63	14:46776	*See* UCRL–101256			
64	14:46010	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016908/JAW	MF-830
CONF-890739–		(12. international colloquium on the dynamics of explosions and reactive systems; 23-28 Jul 1989)			
4	14:45078	*See* SAND–89-1086C			
CONF-890756–		(17. international symposium on shock waves and shock tubes (STS-17); 17-21 Jul 1989)			
1	14:46661	*See* UCRL–101506			
CONF-890760–		(31. Rocky Mountain conference on analytical chemistry; 30 Jul - 4 aug 1989)			
1	14:44772	*See* WHC-SA–0493			
CONF-890798–		(AIRAPT and EHPRG international high pressure science and technology conference; 17-21 Jul 1989)			
8	14:46381	*See* UCRL–100983			
9	14:45699	*See* UCRL–101488			
10	14:46410	*See* LA-UR–89-2798			
CONF-890803–		(International conference on high energy accelerators; 20-26 Aug 1989)			
1	14:45966	*See* SLAC-PUB–5050			
2	14:45936	*See* SLAC-PUB–5049			
3	14:45964	*See* SLAC-PUB–5026			
4	14:45917	*See* SLAC-PUB–5024			
5	14:45933	*See* LA-UR–89-2795			
6	14:45960	*See* LA-UR–89-2792			
7	14:45930	*See* DOE/ER/10666–1			
8	14:45965	*See* SLAC-PUB–5034			
9	14:45968	*See* SLAC-PUB–5059			
CONF-890805–		(5. international workshop on glasses and ceramics from gels; 6-10 Aug 1989)			
1-Draft	14:45630	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016161/JAW	MF-401
CONF-8908101–		(International Union of Radio Science international symposium on electromagnetic theory; 14-17 Aug 1989)			
1	14:46024	*See* UCRL–100242			
CONF-8908105–		(North Atlantic Treaty Organization advanced research workshop in real-time integration methods for mechanical system simulation; 8-11 Aug 1989)			
1	14:46775	*See* UCRL–101208			
CONF-8908108–		(American Statistical Association meeting; 9 Aug 1989)			
1	14:46071	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015364/JAW	MF-408
2	14:46764	*See* PNL-SA–17221			
CONF-8908109–		(Neutron calibration techniques workshop; 1-3 Aug 1989)			
1	14:46669	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015355/JAW	MF-420
CONF-890811–		(9. international symposium on detonation; 28 Aug - 1 sep 1989)			
5	14:46035	*See* SAND–88-2385C			
6	14:46038	*See* SAND–88-2766C			
8	14:46030	*See* LA-UR–89-602			
18	14:46029	*See* LA-UR–89-407			

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19	14:46028	*See* LA-UR–89-376			
27	14:46037	*See* SAND–88-2618C			
CONF-8908111–		(2. workshop on military robotics applications; 8-11 Aug 1989)			
1	14:45745	*See* SAND–89-1180C			
CONF-8908112–		(IUTAM symposium on topological fluid mechanics; Aug 1989)			
1	14:46671	*See* DOE/ER/53212–142			
2	14:46416	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016785/JAW	MF-410
CONF-8908116–		(15. international conference on very large data bases; 22-25 Aug 1989)			
1	14:46761	*See* LBL–26601			
CONF-8908117–		(8. international congress on photosynthesis; 6-11 Aug 1989)			
1	14:46201	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016264/JAW	MF-408
CONF-8908118–		(24. congress of the International Association of Theoretical and Applied Limnology; 13-19 Aug 1989)			
1	14:46323	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016291/JAW	MF-402
CONF-8908119–		(BWR stability symposium; 10-11 Aug 1989)			
1	14:45020	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016233/JAW	MF-000
CONF-890812–		(American Physical Society topical conference on shock compression of condensed matter; 14-17 Aug 1989)			
8	14:45777	*See* SAND–89-0919C			
9	14:45567	*See* SAND–89-0848C			
10	14:45498	*See* SAND–89-0933C			
12	14:45696	*See* SAND–89-0990C			
13	14:45836	*See* SAND–89-1056C			
14	14:45698	*See* UCRL–101434			
15	14:45497	*See* SAND–89-0920C			
16	14:45568	*See* SAND–89-0967C			
17	14:45570	*See* SAND–89-2013C			
18	14:45774	*See* SAND–89-0781C			
19	14:45569	*See* SAND–89-1022C			
20	14:45499	*See* SAND–89-0998C			
21	14:46032	*See* LA-UR–89-2723			
27	14:46419	*See* LA-UR–89-2800			
30	14:46652	*See* LA-UR–89-2656			
31	14:45533	*See* LA-UR–89-2691			
32	14:46031	*See* LA-UR–89-2716			
34	14:45487	*See* LA-UR–89-2967			
36	14:45486	*See* LA-UR–89-2818			
37	14:46040	*See* SAND–89-1043C			
38	14:46034	*See* LA-UR–89-2791			
39	14:45485	*See* LA-UR–89-2701			
CONF-8908120–		(SPIE conference on EUV, X-ray, and gamma ray instrumentation for astronomy and atomic physics; 7-11 Aug 1989)			
2	14:46374	*See* LA-UR–89-2246			
CONF-8908121–		(Electronic Authorization and Routing System EARS meeting; 7 Aug 1989)			
1	14:46755	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016078/JAW	MF-405
CONF-8908122–		(NATO workshop on localization of energy in proteins; 1-5 Aug 1989)			
1	14:46407	*See* LA-UR–89-2446			
2	14:46408	*See* LA-UR–89-2453			
CONF-8908123–		(Severe accident management workshop; 9 Aug 1989)			
1-Vugraphs	14:45154	*See* SAND–89-1863C			
CONF-8908125–		(Post-SMIRT conference No. 2; 21-22 Aug 1989)			
1	14:45036	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016069/JAW	MF-523
2	14:45066	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016261/JAW	MF-000
3	14:45067	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016265/JAW	MF-000
4	14:45029	*See* PNL-SA–16973			
5	14:45030	*See* PNL-SA–16974			
CONF-8908128–		(Western Regional Strain Gage Committee meeting; 22 Aug 1989)			
1	14:46033	*See* LA-UR–89-2734			

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CONF-8908129–		(12. workshop on nuclear physics; 28 Aug - 1 sep 1989)			
1	14:46543	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016849/JAW	MF-413
CONF-8908130–		(SPIE conference on real-time signal processing XII; 10-11 Aug 1989)			
1	14:46773	*See* UCRL–100283			
CONF-8908133–		(24. Yamada conference on strongly coupled plasma physics; 29 Aug - 2 sep 1989)			
1	14:46688	*See* LA-UR–89-2899			
CONF-8908134–		(11. international free electron laser conference; 28 Aug - 1 sep 1989)			
3	14:45834	*See* LA-UR–89-2938			
CONF-890814–		(American Institute of Chemical Engineer's summer national meeting; 20-23 Aug 1989)			
2	14:44837	*See* SAND–89-1398C			
3	14:46340	*See* UCRL–101717			
6	14:46753	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016847/JAW	MF-706
CONF-890815–		(24. intersociety energy conversion engineering conference; 6-11 Aug 1989)			
18	14:45870	*See* SAND–89-1625C			
23	14:45325	NTIS, PC A02/MF A01 - OSTI		DE89015981/JAW	MF-350
24	14:45166	*See* PNL-SA–17038			
CONF-890819–		(ASME/AIChE national heat transfer conference; 6-9 Aug 1989)			
	14:45761	*See* N–89-22652			
20	14:45397	*See* PNL-SA–16415			
CONF-890820–		(4. international symposium on environmental degradation of materials in nuclear power systems: water reactors; 6-10 Aug 1989)			
3	14:45496	*See* PNL-SA–17213			
CONF-890821–		(13. international conference on atomic collisions in solids; 7-11 Aug 1989)			
2	14:46575	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016864/JAW	MF-401
CONF-890826–		(International nuclear physics conference; 20-26 Aug 1989)			
1	14:46540	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016850/JAW	MF-413
2	14:46541	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017243/JAW	MF-413
CONF-890828–		(2. world congress on heating, ventilating, refrigerating and air conditioning; 27 Aug - 1 sep 1989)			
1	14:45380	*See* PNL-SA–16451			
CONF-890829–		(6. international symposium on high voltage engineering (ISHVE-6); 28 Aug - 1 sep 1989)			
1	14:46388	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016851/JAW	MF-220
2	14:46389	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016879/JAW	MF-220
CONF-890836–		(33. SPIE annual international technical symposium on optical and optoelectronic applied science and engineering; 6-11 Aug 1989)			
5	14:46380	*See* UCRL–100710			
7	14:45504	*See* UCRL–101275			
8	14:44944	*See* SAND–89-0839C			
9	14:45969	*See* UCRL–100366			
CONF-890850–		(11. international conference on magnet technology; 28 Aug - 1 sep 1989)			
1	14:46702	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016866/JAW	MF-423
CONF-890851–		(Polycrystalline thin film program meeting; 16-18 Aug 1989)			
	14:44904	*See* SERI/CP–211-3550			
CONF-890854–		(11. annual DOE low level waste management conference; 22-24 Aug 1989)			
8	14:44699	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016218/JAW	MF-402;MN-407
9	14:44700	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016255/JAW	MF-721
CONF-890855–		(10. international conference on Structural Mechanics in Reactor Technology (SMIRT); 14-18 Aug 1989)			
50	14:45112	*See* BNL–42823			
CONF-890864–		(3. American Glovebox Society annual conference and equipment display; 21-24 Aug 1989)			
1-Vugraphs	14:44812	*See* Y/MA–6817			

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CONF-890895–		(Polarization and correlation in electronic and atomic collisions; 2-4 Aug 1989)			
2	14:46409	*See* LA-UR–89-2724			
CONF-890902–		(198. American Chemical Society national meeting; 10-15 Sep 1989)			
1	14:45560	*See* LA-UR–89-1127			
2	14:45167	*See* SAND–89-0700C			
3	14:44431	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011229/JAW	MF-401
4	14:44439	*See* SAND–89-0725C			
5	14:45727	*See* SAND–89-0871C			
6	14:46725	*See* UCRL–100798			
7	14:46011	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012382/JAW	MF-401
8	14:44427	*See* SAND–89-0853C			
9	14:44429	*See* SAND–89-1216C			
10	14:44415	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012341/JAW	MF-109
11	14:44416	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013045/JAW	MF-109
12	14:45691	*See* LA-UR–89-2170			
13	14:44432	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016645/JAW	MF-113
14	14:44423	*See* EGG-M–89052			
CONF-890909–		(8. world clean air congress and exhibition; 11-15 Sep 1989)			
1	14:46332	*See* UCRL–100511			
CONF-8909109–		(21. biennial conference of the Institute for Briquetting and Agglomeration; 27-30 Sep 1989)			
1	14:44989	*See* EGG-M–28487			
CONF-890911–		(International conference on operability of nuclear systems in normal and adverse environments; 18-22 Sep 1989)			
1	14:45072	*See* SAND–88-1849C			
2	14:45073	*See* SAND–88-1882C			
4	14:45075	*See* SAND–88-2172C			
5	14:45074	*See* SAND–88-2161C			
6	14:45153	*See* SAND–88-2171C			
7	14:45076	*See* SAND–89-1099C			
CONF-8909110–		(16. annual conference of the American Society for Quality Control; 17-20 Sep 1989)			
2	14:45081	*See* DP-MS–89-79			
3	14:46739	*See* LA-UR–89-2027			
5	14:44775	*See* WHC-SA–0624			
CONF-8909111–		(Computer graphics world computervision international user conference; 10-13 Sep 1989)			
1	14:45780	*See* UCRL–100718			
CONF-8909112–		(Symposium lattice '88; 22-25 Sep 1989)			
1	14:46486	*See* BNL–42493			
CONF-8909113–		(14. international pyrotechnics seminar; 18-22 Sep 1989)			
	14:45853	*See* SAND–89-0271C			
1	14:45162	*See* SAND–89-0252C			
2	14:46039	*See* SAND–89-0320C			
3	14:45726	*See* SAND–89-0482C			
CONF-8909114–		(Galvatech '89 conference; 5-7 Sep 1989)			
	14:45488	*See* LBL–26935			
CONF-8909120–		(American Physical Society (APS) meeting; 5-8 Sep 1989)			
1	14:45631	NTIS, PC A02/MF A01 - OSTI		DE89010337/JAW	MF-404
2	14:45441	*See* LA-UR–89-2403			
CONF-8909124–		(International conference on lightning and static electricity; 26-28 Sep 1989)			
1	14:46066	*See* SAND–89-1161C			
2	14:46064	*See* SAND–88-3470C			
3	14:46065	*See* SAND–88-3471C			
CONF-8909125–		(11. international RERTR meeting; 19-22 Sep 1989)			
1	14:45077	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012386/JAW	MF-526
CONF-8909126–		(3. international conference on human computer interaction; 18-22 Sep 1989)			
1	14:46774	*See* UCRL–100958			
CONF-8909127–		(1. international machinery monitoring and diagnostic conference; 11-14 Sep 1989)			
1	14:46756	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012509/JAW	MF-705
2	14:45068	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012335/JAW	MF-000

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CONF-8909128–		(Oceans '89 conference; 18-21 Sep 1989)			
1	14:44921	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013278/JAW	MF-234
CONF-8909129–		(Fuel Division national meeting; 10-15 Sep 1989)			
1	14:44428	*See* SAND–89-0883C			
CONF-8909130–		(First international machinery monitoring and diagnostic conference; 11-14 Sep 1989)			
1	14:45079	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89012430/JAW	MF-520
CONF-8909139–		(Meeting on supercomputers: emerging applications in manufacturing; 11-13 Sep 1989)			
1	14:46768	*See* SAND–89-1452C			
CONF-8909146–		(2. annual IEEE/ASIC seminar and exhibit; 25-28 Sep 1989)			
1	14:45869	*See* SAND–89-0841C			
2	14:46769	*See* SAND–89-1542C			
CONF-8909147–		(American Voice Input/Output Society meeting; Sep 1989)			
1	14:45760	*See* LA-UR–89-1833			
2	14:44734	*See* LA-UR–89-1939			
CONF-890916–		(6. annual international Pittsburgh coal conference; 25-29 Sep 1989)			
1	14:44430	*See* SAND–89-7072C			
CONF-8909161–		(6. international conference on optical fiber sensors; 17-20 Sep 1989)			
1	14:46019	*See* LA-UR–89-2112			
CONF-8909163–		(5. symposium on containment of underground nuclear explosions; 19-21 Sep 1989)			
1	14:45501	*See* SAND–89-1331C			
CONF-8909167–		(IROS '89: international workshop on intelligent robots and systems: the autonomous robot and its application; 4-6 Sep 1989)			
1	14:45775	*See* SAND–89-0788C			
2	14:45744	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015916/JAW	MF-406
CONF-8909168–		(Society of Automotive Engineers (SAE) aerotech '89; 25-28 Sep 1989)			
1	14:45778	*See* SAND–89-1881C			
CONF-8909169–		(18. North American Thermal Analysis Society conference; 24-27 Sep 1989)			
1	14:45559	*See* KCP–613-4113			
CONF-8909170–		(12. annual Madison waste conference; 20-21 Sep 1989)			
1	14:46134	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015896/JAW	MF-721
CONF-8909171–		(2. international conference on brazing, high-temperature brazing and diffusion welding; 19-20 Sep 1989)			
1	14:45505	*See* UCRL–101547			
CONF-8909172–		(SIMS VII: 7th international conference on secondary ion mass spectrometry; 3-8 Sep 1989)			
1	14:45586	NTIS, PC A02/MF A01 - OSTI		DE89015978/JAW	MF-401
CONF-8909173–		(11. international conference on the properties of steam (ICPS); 3-9 Sep 1989)			
1	14:46355	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016226/JAW	MF-252
CONF-8909174–		(16. Leeds-Lyon symposium on tribology; 5-8 Sep 1989)			
1	14:45555	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015986/JAW	MF-332
CONF-8909176–		(EOS electrostatic discharge symposium; 26-28 Sep 1989)			
1	14:45772	*See* SAND–89-0194C			
CONF-8909177–		(Optical engineering/fibers '89 meeting; 5-8 Sep 1989)			
1	14:46766	*See* SAND–89-0220C			
CONF-8909178–		(US-Korea joint seminar on fluids engineering and science; 3-9 Sep 1989)			
1	14:44449	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016320/JAW	MF-114
CONF-8909179–		(11. international symposium on military applications of blast simulation; 10-13 Sep 1989)			
1	14:44920	*See* SAND–88-2862C			
CONF-8909183–		(14. meeting on linear accelerators; 7-9 Sep 1989)			
1	14:45967	*See* SLAC-PUB–5054			
CONF-890924–		(12. biennial ASME conference on mechanical vibration and noise; 17-20 Sep 1989)			
1	14:45771	*See* SAND–88-3045			

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CONF-890925–		(9. European photovoltaic solar energy conference and exhibition; 25-29 Sep 1989)			
1	14:44902	*See* SAND–89-0339C			
CONF-890926–		(9. international symposium on detonation; Sep 1989)			
1	14:46027	*See* LA-UR–88-3161			
2	14:46036	*See* SAND–88-2465C			
CONF-890927–		(3. international conference on new frontiers for hazardous waste management; 10-13 Sep 1989)			
1	14:44771	*See* WHC-SA–0367			
CONF-890928–		(Nuclear waste isolation in the unsaturated zone: FOCUS '89; 18-21 Sep 1989)			
1	14:44735	*See* LA-UR–89-2541			
2	14:44736	*See* LA-UR–89-2573			
CONF-890931–		(13. conference on the numerical simulation of plasmas; 17-20 Sep 1989)			
1	14:46665	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015904/JAW	MF-420
2	14:46666	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015907/JAW	MF-420
3	14:46375	*See* LA-UR–89-2517			
CONF-890935–		(International workshop on new developments in occupational dose control and ALARA implementation at nuclear power plants and similar facilities; 18-21 Sep 1989)			
1	14:46316	*See* WHC-SA–0484			
CONF-890941–		(Conference on applications of supercomputers in engineering; 5-7 Sep 1989)			
1	14:46418	*See* LA-UR–89-2429			
2	14:46760	*See* LA-UR–89-2706			
CONF-890953–		(International conference on the physics of highly correlated electron systems; 11-15 Sep 1989)			
1	14:46629	*See* LA-UR–89-2564			
CONF-890975–		(7. international conference on heavy metals in the environment; 12-15 Sep 1989)			
1	14:46182	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89013056/JAW	MF-402
2	14:46167	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014099/JAW	MF-000
CONF-890976–		(International symposium on mathematical modeling of roof systems; 15-16 Sep 1989)			
1	14:45326	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007817/JAW	MF-95D
CONF-890977–		(International congress on intergranular and interphase boundaries in materials; 4-8 Sep 1989)			
1	14:45534	*See* LA-UR–89-2929			
CONF-890987–		(ASME design conference; 17-20 Sep 1989)			
1	14:45868	*See* SAND–89-0544C			
2	14:45566	*See* SAND–89-0545C			
CONF-890993–		(6. conference on computing in civil engineering; 11-13 Sep 1989)			
1	14:44773	*See* WHC-SA–0571			
CONF-890995–		(2. international seminar on surface engineering by high energy beams; 5-7 Sep 1989)			
1	14:45523	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010129/JAW	MF-404
CONF-890996–		(Sensor's expo '89; 12-14 Sep 1989)			
1	14:46016	*See* EGG–10617-6055			
2	14:46012	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013539/JAW	MF-406
3	14:45857	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014763/JAW	MF-404
4	14:46013	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014754/JAW	MF-406
5	14:45752	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014072/JAW	MF-406
CPA–					
1988	14:44462	Canadian Petroleum Association, 3800 150 6th. Ave. S.W., Calgary, Alta., CAN T2P 3Y7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CPS–					
89-004	14:45552	*See* AD-A–208119/8/XAB			
EE-113	14:44511	Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
CPS–					
EPS9/HA/1	14:46135	Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SPE9/HA/1	14:46136	Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CRA–					
W62-11-88-8-9E	14:45881	Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
CRDEC-TR–					
047	14:44510	*See* AD-A–208243/6/XAB			
CRN-PN–					
88-32	14:46520	NTIS (US Sales Only), PC A03/MF A01		DE89908091/JAW	MF-000
CRREL-SP–					
89-9	14:46163	*See* AD-A–208109/9/XAB			
CTA-EAV-NT–					
007/80	14:45060	NTIS (US Sales Only), PC A13/MF A01 - OSTI; INIS		DE89636449/JAW	MF-000
CTA-IEAv-NT–					
001/89	14:44663	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636513/JAW	MF-000
CTP–					
1745	14:46489	*See* CONF-8903130–2			
1765	14:46426	*See* CONF-8905143–12			
CTP-TAMU–					
1/89	14:46494	*See* IC–89/71			
CU/FE–					
87-04003	14:45459	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
DAF–					
212	14:44978	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
DDC–					
89-01	14:45434	*See* AD-A–207754/3/XAB			
DGMK–					
202-4/1	14:44475	Copy held by UB/TIB Hannover.			MF-000
202-4/2	14:44476	Copy held by UB/TIB Hannover.			MF-000
202-4/3	14:44477	Copy held by UB/TIB Hannover.			MF-000
202-4/4	14:44478	Copy held by UB/TIB Hannover.			MF-000
361	14:44469	Copy held by UB/TIB Hannover.			MF-000
388	14:44507	Copy held by UB/TIB Hannover.			MF-000
393	14:44529	Copy held by UB/TIB Hannover.			MF-000
DLG–					
538031	14:46324	NTIS (US Sales Only), PC A03/MF A01; NTIS (US Sales Only), PC A03/MF A01		DE89910932/JAW	MF-000
DNV/C–					
W62-11-88-11-1E	14:45884	Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
W62-11-88-2E	14:45882	Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
W62-11-88-6E	14:45883	Public Works Canada, Information Research & Library Services, Sir Charles Tupper Bldg., Confederation Heights, Ottawa, ON, CAN K1A 0M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
DOE-RW–					
89.029	14:44711	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89633767/JAW	MF-000
89.034	14:44674	*See* AERE-R–13358			
DOE/BC/14126–					
9	14:44479	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000757/JAW	PC-122
10	14:44480	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000758/JAW	PC-122
DOE/CE–					
0257	14:45435	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015566/JAW	MF-336
0260-Draft	14:45186	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016066/JAW	MF-231;MN-232
0269	14:45228	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017227/JAW	MF-121
DOE/CE/10509–					
H2	14:45209	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016061/JAW	MF-350
DOE/CE/30806–					
T1	14:45338	NTIS (US Sales Only), PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016319/JAW	MF-232
T2	14:44929	NTIS (US Sales Only), PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016112/JAW	MF-232
T4	14:45339	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016010/JAW	MF-232
T6	14:45340	NTIS, PC A06/MF A01 - OSTI		DE89016012/JAW	MF-232
T7	14:45341	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016013/JAW	MF-232
T8	14:45342	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016014/JAW	MF-232
T9	14:45343	NTIS, PC A08/MF A01 - OSTI		DE89016015/JAW	MF-232
DOE/CE/50111–					
H1	14:45436	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016067/JAW	MF-336
DOE/DP–					
0068	14:46044	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016065/JAW	MF-700
DOE/EH–					
0092	14:45114	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017235/JAW	MF-630
DOE/EIA–					
0035(89/04)	14:45229	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016553/JAW	MF-950
0109(89/06)	14:45230	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016736/JAW	MF-950
0121(89/1Q)	14:45231	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015599/JAW	MF-950
0125(89/1Q)	14:45232	NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016737/JAW	MF-950
0130(89/06)	14:44603	NTIS, PC A07/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016740/JAW	MF-950
0191(88)	14:45237	NTIS, PC A11/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015596/JAW	MF-950
0380(88/05)	14:44506	NTIS, PC A08/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015568/JAW	MF-950
0474(89)	14:45238	NTIS, PC A05/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89015567/JAW	MF-950
0520(89/08)	14:45233	NTIS, PC A03/MF A01 - GPO - OSTI; GPO Dep.	E 1.99:	DE89016550/JAW	MF-950
DOE/ER–					
0149	14:44802	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015621/JAW	MF-402
0415	14:45187	NTIS, PC A25/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015180/JAW	PC-404
0421	14:46670	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015617/JAW	MF-420
DOE/ER/03075–					
T2	14:46449	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016497/JAW	MF-414
DOE/ER/10666–					
1	14:45930	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015748/JAW	MF-414
DOE/ER/10742–					
3	14:46582	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016896/JAW	MF-411
DOE/ER/13065–					
587	14:46450	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016336/JAW	MF-414
DOE/ER/13309–					
4	14:45833	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016788/JAW	MF-406
DOE/ER/13592–					
3	14:45724	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016739/JAW	MF-401
DOE/ER/13594–					
T2	14:44891	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016272/JAW	MF-408
DOE/ER/13719–					
3	14:44834	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016450/JAW	MF-408
DOE/ER/13721–					
T1	14:46356	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016277/JAW	MF-403
DOE/ER/13902–					
1	14:46417	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016568/JAW	MF-411

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DOE/ER/25009–					
806	14:46757	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016385/JAW	MF-405
DOE/ER/40048–					
223-L9	14:46544	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017318/JAW	MF-413
225-L9	14:46545	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017310/JAW	MF-413
DOE/ER/40316–					
3	14:46546	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016470/JAW	MF-413
DOE/ER/40319–					
T1	14:46015	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016661/JAW	MF-404;MN-406
DOE/ER/40326–					
9	14:46525	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015615/JAW	MF-414
DOE/ER/40334–					
4	14:46547	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016573/JAW	MF-413
DOE/ER/40423–					
03-P9	14:46490	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017322/JAW	MF-414
05-P9	14:46451	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017323/JAW	MF-414
DOE/ER/45063–					
1	14:45524	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016275/JAW	MF-404
DOE/ER/45069–					
3	14:45525	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016787/JAW	MF-404
DOE/ER/45233–					
4	14:46583	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016741/JAW	MF-411
DOE/ER/45268–					
T1	14:46620	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016744/JAW	MF-410
DOE/ER/45310–					
19	14:45460	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015541/JAW	MF-404
DOE/ER/45370–					
1	14:46584	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016023/JAW	MF-411
DOE/ER/53212–					
142	14:46671	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015207/JAW	PC-427
DOE/ER/53217–					
3	14:46672	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017363/JAW	MF-427
DOE/ER/53218–					
10	14:46673	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017315/JAW	MF-421
DOE/ER/53257–					
2	14:46674	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016574/JAW	MF-427
DOE/ER/53266–					
25	14:46675	NTIS, PC A03/MF A01; OTI; GPO Dep.	E 1.99:	DE89016619/JAW	MF-420
DOE/ER/60292–					
5	14:46072	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016309/JAW	MF-402
DOE/ER/60590–					
T1	14:46368	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016318/JAW	MF-412
T2	14:46059	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016113/JAW	MF-402
DOE/ER/69014–					
T1	14:46073	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016251/JAW	MF-408
DOE/ET/10815–					
128	14:45312	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016747/JAW	MF-112
DOE/ET/34013–					
14	14:45037	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015169/JAW	PC-523
DOE/ET/51013–					
271	14:46676	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016052/JAW	MF-426
272	14:46677	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016051/JAW	MF-422
273	14:46678	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016050/JAW	MF-420;MN-421;MN-422
T214	14:46703	NTIS, PC A06/MF A01 - OSTI		DE89016059/JAW	MF-425
DOE/ET/53088–					
374	14:46679	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016727/JAW	MF-421
385	14:46680	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016726/JAW	MF-427
386	14:46681	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016728/JAW	MF-422
DOE/FC/10626–					
2736	14:44409	NTIS, PC A09/MF A01 - OSTI		DE89016555/JAW	MF-104
DOE/FE–					
0116-1	14:44467	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016549/JAW	MF-126
0130	14:46735	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015574/JAW	MF-133
0139	14:44463	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015643/JAW	MF-121
0140	14:45234	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016685/JAW	MF-101;MN-102

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DOE/FTR–					
9015526	14:45955	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015526/JAW	MF-414
DOE/ID–					
10232	14:45444	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016208/JAW	MF-333
22080	14:44704	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016170/JAW	MF-502
DOE/ID/12545–					
1-Vol.1	14:45461	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009030/JAW	PC-312;STD-312
1-Vol.2	14:45462	NTIS, PC A21/MF A01 - OSTI		DE89009031/JAW	PC-312;STD-312
1-Vol.2A	14:45463	NTIS, PC A99/MF A01 - OSTI		DE89009032/JAW	PC-312;STD-312
1-Vol.3	14:45464	NTIS, PC A14/MF A01 - OSTI		DE89009033/JAW	PC-312;STD-312
1-Vol.4	14:45465	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009034/JAW	PC-312;STD-312
1-Vol.5	14:45466	NTIS, PC A14/MF A01 - OSTI		DE89009035/JAW	PC-312;STD-312
DOE/IG–					
0269	14:45171	OSTI		TI89014003/JAW	PC-950
DOE/LLW–					
53T	14:44705	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016018/JAW	MF-721
58T	14:44706	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016017/JAW	MF-721
76T	14:44707	NTIS, PC A15/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015581/JAW	MF-512
DOE/MA/00356–					
H4	14:46736	NTIS, PC A18/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015175/JAW	MF-900
DOE/MC/21063–					
2706	14:44417	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000973/JAW	MF-109
2707	14:44418	NTIS, PC A09/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000974/JAW	MF-109
2708	14:44419	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000975/JAW	MF-109;MN-103
DOE/METC–					
88/0261	14:44481	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE88001050/JAW	MF-122
89/4089	14:44835	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000938/JAW	MF-108
89/6104	14:45188	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000949/JAW	MF-101
DOE/NASA–					
0168-11	14:45437	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016022/JAW	MF-336
DOE/NE/37959–					
33	14:45080	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016239/JAW	MF-505
DOE/NE/37961–					
1	14:45206	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016386/JAW	MF-500
DOE/NE/37963–					
10	14:45467	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017266/JAW	MF-504
11	14:45468	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017267/JAW	MF-504
DOE/NE/37970–					
T10	14:45115	NTIS, PC A06/MF A01 - OSTI; INIS; GPO Dep.	E 1.99:	DE89016452/JAW	MF-523
DOE/NE/44139–					
42	14:44803	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89009021/JAW	PC-510;STD-510
51	14:44804	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015324/JAW	PC-510;STD-510
57	14:44708	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89009016/JAW	PC-510;STD-510
DOE/NV/10630–					
T2	14:46286	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015931/JAW	MF-707
DOE/OR/21548–					
062	14:44805	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016202/JAW	MF-511

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DOE/OSTI–					
8200-R52	14:45018	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014401/JAW	PC-500;SSP-522;SSP-523;SSP-530;STD-500;STD-522;STSTDS;STD-530
DOE/PC/70028–					
T11	14:44836	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015524/JAW	MF-108
DOE/PC/79901–					
T4	14:44450	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015998/JAW	MF-104
DOE/PC/79925–					
6	14:44433	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015592/JAW	MF-113
DOE/PC/80535–					
T3-Pt.1	14:44434	NTIS, PC A17/MF A01 - OSTI		DE89015604/JAW	MF-108
T3-Pt.2	14:44435	NTIS, PC A15/MF A01 - OSTI		DE89015605/JAW	MF-108
T3-Pt.3	14:44436	NTIS, PC A15/MF A01 - OSTI		DE89015606/JAW	MF-108
T3-Pt.4	14:44437	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015607/JAW	MF-108
DOE/PC/88813–					
T3	14:44420	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015995/JAW	MF-108
DOE/PC/88884–					
T2	14:44410	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015999/JAW	MF-102
T3	14:44411	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015591/JAW	MF-102
DOE/PC/88886–					
T3	14:44412	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015589/JAW	MF-102
DOE/PC/88920–					
T3	14:44421	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015593/JAW	MF-102
DOE/PC/88927–					
T3	14:44443	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015590/JAW	MF-106
DOE/PC/88937–					
T4	14:44451	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015996/JAW	MF-103
DOE/PC/88942–					
T2	14:44422	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015602/JAW	MF-108
DOE/PC/90274–					
T4	14:45313	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015997/JAW	MF-112
DOE/PETC/TR–					
89/8	14:44413	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016405/JAW	PC-102;STD-102
DOE/RA/50219–					
T9	14:46338	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015528/JAW	MF-220
DOE/RL–					
89-02	14:44709	NTIS, PC A19/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016173/JAW	MF-500
89-03	14:44710	NTIS, PC A17/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016174/JAW	MF-510
89-11	14:46137	NTIS, PC A05/MF A01 - OSTI		DE89016244/JAW	MF-507;MN-502
DOE/RW–					
0043-Rev.3	14:45207	OSTI		TI89015204/JAW	MF-800
0225-1	14:44712	OSTI		TI89015573/JAW	MF-800
0238	14:44713	OSTI		TI89016062/JAW	MF-812
0239	14:44714	OSTI		TI89015571/JAW	MF-812
0244	14:44715	OSTI		TI89015572/JAW	MF-814
DOE/S–					
0070	14:44716	NTIS, PC A19/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015619/JAW	MF-902
DOE/SF/17169–					
T13	14:45526	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016493/JAW	MF-504
DOE/SSDP–					
0066	14:44806	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016831/JAW	MF-511
0068	14:44807	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016832/JAW	MF-511
0069	14:44808	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016833/JAW	MF-511
DOE/WIPP–					
87-010	14:44717	NTIS, PC A09/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89017240/JAW	MF-815
DOT/FAA/AM–					
89/4	14:46322	*See* AD-A–208195/8/XAB			
DP-MS–					
89-79	14:45081	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013553/JAW	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
DRES-SM–					
1260	14:46321	*See* AD-A–208175/0/XAB			
DTH-LET-NE–					
88-3	14:45438	NTIS (US Sales Only), PC A04/MF A01		DE89914639/JAW	MF-000
DTH-LET-RE–					
88-7	14:44482	NTIS (US Sales Only), PC A09/MF A01		DE89914670/JAW	MF-000
DTH-LV-MEDD–					
205	14:44930	NTIS (US Sales Only), PC A06/MF A01		DE89914669/JAW	MF-000
E–					
4227	14:45763	*See* N–89-22891			
4522	14:44895	*See* N–89-16917			
4565	14:45535	*See* N–89-21895			
4666	14:45764	*See* N–89-22919			
4668	14:44896	*See* N–89-22177			
4683	14:45561	*See* N–89-22684			
4701	14:45164	*See* N–89-22710			
4708	14:45163	*See* N–89-22982			
4725	14:45741	*See* N–89-22053			
4747	14:44897	*See* N–89-22651			
4750	14:45761	*See* N–89-22652			
EC–					
8805	14:45181	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EC/CPG–					
8902	14:45189	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EC/IWD–					
1987A	14:44876	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987BC	14:44877	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1987YNT	14:44878	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1988A	14:44879	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1988YNT	14:44880	Water Survey of Canada, Place Vincent Massey, 351 St. Joseph Blvd., Ottawa, ON, CAN K1A 0E7; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EC/NHR/S–					
87004	14:46357	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EC/Q/CP–					
8703	14:46168	Environment Canada. Environmental Protection Publications, 10 Wellington St., 12th PVM, Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EC/RRE–					
1989	14:45445	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ECN–					
89-114	14:46074	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-128	14:45315	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
89-129	14:45316	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
EDR–					
13295	14:45437	*See* DOE/NASA–0168-11			
EF–					
1988	14:45221	Prince Edward Island. Dept. of Energy and Forestry, Shaw Bldg., 105 Rochford St., PO Box 2000, Charlottetown, PE, CAN C1A 7N8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EFG–					
1988	14:45305	Prince Edward Island. Dept. of Energy and Forestry, Shaw Bldg., 105 Rochford St., PO Box 2000, Charlottetown, PE, CAN C1A 7N8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EFI-TR–					
3543	14:44979	NTIS (US Sales Only), PC A05/MF A01		DE89914734/JAW	MF-000
3547	14:45344	NTIS (US Sales Only), PC A03/MF A01		DE89914784/JAW	MF-000
3562	14:45006	NTIS (US Sales Only), PC A03/MF A01		DE89914731/JAW	MF-000
EGG–					
10617-6055	14:46016	NTIS, PC A03/MF A01 - OSTI		DE89009337/JAW	MF-506
10617-6065	14:46352	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016314/JAW	MF-705
2564	14:46122	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015210/JAW	PC-510
EGG-BNCT–					
8353-Vol.3-No.3	14:46287	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016270/JAW	MF-408
8353-Vol.3-No.4	14:46288	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016269/JAW	MF-507;MN-505
EGG-EP–					
8486	14:45410	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016360/JAW	MF-310
EGG-FSP–					
8552	14:46289	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016210/JAW	MF-507
EGG-M–					
14487	14:46017	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010981/JAW	MF-506
28487	14:44989	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011099/JAW	MF-502
88311	14:45021	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016216/JAW	MF-000
88370	14:45754	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016191/JAW	MF-513
88372	14:45755	NTIS, PC A03/MF A01 - OSTI		DE89016189/JAW	MF-522
88373	14:45756	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016190/JAW	MF-820
89052	14:44423	NTIS, PC A03/MF A01 - OSTI		DE89016354/JAW	MF-123
89081	14:44947	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016169/JAW	MF-251
89123	14:45875	NTIS, PC A03/MF A01 - OSTI		DE89016358/JAW	MF-500
89154	14:45757	NTIS, PC A02/MF A01 - OSTI		DE89016168/JAW	MF-820
89203	14:46662	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016268/JAW	MF-516
EGG-SSRE–					
8506	14:45587	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016209/JAW	MF-505
EMR/MS–					
8602	14:45411	Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $5.00; OTHER COUNTRIES $6.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
EMR/MTL–					
89-02	14:45858	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ENR/SE–					
1988	14:45210	Alberta Energy and Natural Resources, Information Centre, 9920-108 St., Edmonton, AB, CAN T5K 2M4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
EPA–					
450/2-89/010	14:46099	*See* PB–89-197222/XAB			
450/3-89/017	14:45003	*See* PB–89-203731/XAB			
450/3-89/13	14:45001	*See* PB–89-203699/XAB			
450/3-89/16	14:45002	*See* PB–89-203707/XAB			
600/J-86/503	14:46330	*See* PB–89-201875/XAB			
600/J-87/478	14:46100	*See* PB–89-201859/XAB			
600/J-88/333	14:46102	*See* PB–89-206668/XAB			
600/J-88/336	14:46101	*See* PB–89-206635/XAB			
600/J-89/001	14:46142	*See* PB–89-197768/XAB			
EPA/AA/CTAB–					
89/01	14:45450	*See* PB–89-193973/XAB			
89/02	14:45449	*See* PB–89-193353/XAB			
EPA/ROD/R–					
02-88/060	14:46188	*See* PB–89-204770/XAB			
03-88/039	14:45426	*See* PB–89-211684/XAB			
04-88/040	14:45418	*See* PB–89-209829/XAB			
07-88/030	14:46153	*See* PB–89-204820/XAB			
EPRI-CU–					
6482	14:44945	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-EL–					
6237	14:45007	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6413	14:46060	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6416	14:45588	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6484	14:45282	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-EN–					
6492	14:46075	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-ER–					
6428	14:44990	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6488	14:44438	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-GS–					
6423-Vol.1	14:44998	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6467	14:44991	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6481	14:44444	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
EPRI-NP–					
5680	14:44718	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
5685	14:44719	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
5696	14:45069	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6316	14:45070	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6453	14:44723	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6455	14:45038	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000
6507	14:46758	Research Reports Center, Box 50490, Palo Alto, CA 94303			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ER/C–					
098	14:44512	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ERCB–					
D88-10	14:44624	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
D88-19	14:45283	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
D88-20	14:44608	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
D89-3	14:44524	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
DD89-4	14:44609	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $5.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
IL89-8	14:44525	Energy Resources Conservation Board, 640-5th Ave. SW, Calgary, AB, CAN T2P 3G4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ESC-WR–					
89-14	14:45172	Netherlands Energy Research Foundation ECN, P.O. Box 1, 1755 ZG Petten, Netherlands			ND-000
ETDE-mf–					
9910994	14:45211	NTIS (US Sales Only), PC A09/MF A01; NTIS (US Sales Only), PC A09/MF A01		DE89910994/JAW	MF-000
9914823	14:45439	NTIS (US Sales Only), PC A06/MF A01		DE89914823/JAW	MF-000
9914835	14:46169	NTIS (US Sales Only), PC A05/MF A01		DE89914835/JAW	MF-000
9914837	14:46076	NTIS (US Sales Only), PC A10/MF A01		DE89914837/JAW	MF-000
9914838	14:45440	NTIS (US Sales Only), PC A09/MF A01		DE89914838/JAW	MF-000
9914879	14:44892	NTIS (US Sales Only), PC A15/MF A01		DE89914879/JAW	MF-000
9914883	14:46325	NTIS (US Sales Only), PC A03/MF A01		DE89914883/JAW	MF-000
9914941	14:45354	NTIS (US Sales Only), PC A05/MF A01		DE89914941/JAW	MF-000
9914942	14:44919	NTIS (US Sales Only), PC A03/MF A01		DE89914942/JAW	MF-000
9914943	14:45355	NTIS (US Sales Only), PC A04/MF A01		DE89914943/JAW	MF-000
9914958	14:44414	NTIS (US Sales Only), PC A03/MF A01		DE89914958/JAW	MF-000
ETDE/CA-MS–					
102	14:46123	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1978	14:45306	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
83-02	14:45423	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
M91-7-28-1988E	14:44976	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ETSU-TID–					
4062-P2	14:44973	NTIS (US Sales Only), PC A06/MF A01		DE89914432/JAW	MF-000
ETSU-WN–					
0561-P4	14:44980	NTIS (US Sales Only), PC A03/MF A01		DE89914429/JAW	MF-000
5053	14:44981	NTIS (US Sales Only), PC A06/MF A01		DE89914430/JAW	MF-000
5091	14:44982	NTIS (US Sales Only), PC A06/MF A01		DE89914431/JAW	MF-000
5097-P1	14:44977	NTIS (US Sales Only), PC A08		DE89914428/JAW	MF-000
EUR–					
11526	14:45731	NTIS (US Sales Only), PC A06/MF A01			MF-000
11608	14:46290	European Community Information Service 2100 M St., NW Suite 707 Washington, DC 20037			MF-000
11755	14:45117	NTIS (US Sales Only), PC A08/MF A01			MF-000
FNAL-TM–					
1595	14:45956	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015971/JAW	PC-414
1597	14:45957	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015586/JAW	PC-406
1600	14:45958	NTIS, PC A03/MF A01 - OSTI		DE89014016/JAW	PC-414
1602	14:45990	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014014/JAW	PC-414
1604	14:45991	NTIS, PC A03/MF A01 - OSTI		DE89014015/JAW	PC-414;STD-406
1606	14:45864	NTIS, PC A03/MF A01 - OSTI		DE89015585/JAW	PC-406
1608	14:45931	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015588/JAW	PC-414
1610	14:45992	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016016/JAW	PC-414
FNAL/C–					
89/148-E	14:46435	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016732/JAW	MF-414
89/155-E	14:45989	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016323/JAW	MF-406
89/164-T	14:46491	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016284/JAW	MF-412
89/168-T	14:46452	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016734/JAW	MF-414
FO–					
1987	14:46170	Canada Dept. of Fisheries and Oceans, Scientific Publications, 200 Kent St., 14th Floor, Ottawa, ON, CAN K1A 0E6; $6.00; OTHER COUNTRIES: $7.20 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
FR–					
688102	14:46718	*See* N–89-23300			
FRCR–					
337	14:46675	*See* DOE/ER/53266–25			
FRNC-TH–					
2821	14:45412	NTIS (US Sales Only), PC A05/MF A01		DE89764079/JAW	MF-000
FTC–					
EE-112	14:44513	Environment Canada, Library Services, Terrasses de la Chaudiere, 10 Wellington St., Ottawa, ON, CAN K1A 0H3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GANIL-P–					
88-14	14:46532	NTIS (US Sales Only), PC A02/MF A01		DE89908210/JAW	MF-000
GB–					
194	14:45356	NTIS (US Sales Only), PC A02/MF A01		DE89916370/JAW	MF-000
196	14:45357	NTIS (US Sales Only), PC A03/MF A01		DE89914538/JAW	MF-000
197	14:44457	NTIS (US Sales Only), PC A03/MF A01		DE89916360/JAW	MF-000
GEND-INF–					
090	14:45083	NTIS, PC A09/MF A01 - OSTI		DE89016172/JAW	MF-523
GKSS–					
89/E/8	14:46077	NTIS (US Sales Only), PC A08/MF A01		DE89914972/JAW	MF-000
GML–					
75PE1135	14:44893	CANMET/TID, Energy, Mines and Rescurces Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
GOGLA–					
8902	14:45235	Canada Oil and Gas Lands Administration, 355 River Rd., 15th Floor, Tower B, Ottawa, Ont., CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GRI–					
84/0245	14:44604	*See* PB–89-204051/XAB			
88/0316	14:44605	*See* PB–89-204564/XAB			
88/0361	14:44614	*See* PB–89-204572/XAB			
88/0363	14:44606	*See* PB–89-204580/XAB			
GRL–					
8804	14:46538	*See* AD-A–208071/1/XAB			
GRS–					
455	14:45190	NTIS (US Sales Only), PC A07/MF A01		DE89914762/JAW	MF-000
589	14:45182	NTIS (US Sales Only), PC A08/MF A01		DE89914757/JAW	MF-000
592	14:45304	NTIS (US Sales Only), PC A05/MF A01		DE89914758/JAW	MF-000
605	14:45219	NTIS (US Sales Only), PC A05/MF A01		DE89914761/JAW	MF-000
644A	14:45191	NTIS (US Sales Only), PC A04/MF A01		DE89914759/JAW	MF-000
652	14:44886	NTIS (US Sales Only), PC A05/MF A01		DE89914747/JAW	MF-000
667	14:45174	NTIS (US Sales Only), PC A05/MF A01		DE89914752/JAW	MF-000
679	14:45192	NTIS (US Sales Only), PC A04/MF A01		DE89914763/JAW	MF-000
69	14:45126	NTIS (US Sales Only), PC A06/MF A01		DE89914983/JAW	MF-000
734	14:45193	NTIS (US Sales Only), PC A04/MF A01		DE89914760/JAW	MF-000
GRS-F–					
175	14:45134	NTIS (US Sales Only), PC A04/MF A01		DE89915117/JAW	MF-000
GS–					
89-1H	14:46342	Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
GSI–					
89-09	14:45932	NTIS (US Sales Only), PC A05/MF A01		DE89915121/JAW	MF-000
89-12	14:45993	NTIS (US Sales Only), PC A06/MF A01		DE89915119/JAW	MF-000
89-13	14:45994	NTIS (US Sales Only), PC A07/MF A01		DE89915120/JAW	MF-000
89-15	14:46509	NTIS (US Sales Only), PC A12/MF A01		DE89915167/JAW	MF-000
89-16	14:46548	NTIS (US Sales Only), PC A06/MF A01		DE89915118/JAW	MF-000
89-49(prepr.)	14:46402	NTIS (US Sales Only), PC A03/MF A01		DE89915142/JAW	MF-000
89-50(prepr.)	14:46549	NTIS (US Sales Only), PC A03/MF A01		DE89915141/JAW	MF-000
89-52(prepr.)	14:46550	NTIS (US Sales Only), PC A03/MF A01		DE89915140/JAW	MF-000
HEDL–					
7641	14:44724	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016058/JAW	MF-813
HL–					
89/1077	14:46146	*See* NSS/G–103			
89/1080	14:44737	*See* NSS/R–134			
89/1528	14:46114	*See* NSS/R–137			
HPC-R–					
3-1	14:45358	IEA Heat Pump Center, Eggenstein-Leopoldshafen (Germany, F.R.)			ND-000
HQ–					
1988	14:45284	Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, PQ, CAN H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8903	14:45285	Hydro-Quebec, Centre de diffusion, 75, boul. Dorchester ouest, 14e etage, Montreal, PQ, CAN H2Z 1A4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
HW–					
11642	14:46171	NTIS, PC A02/MF A01 - OSTI		DE89016478/JAW	MF-600
39974	14:44809	NTIS, PC A02/MF A01 - OSTI		DE89016477/JAW	MF-707
56242	14:46183	NTIS, PC A03/MF A01 - OSTI		DE89016479/JAW	MF-701
81300	14:44810	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016480/JAW	MF-721
IABG-B-SZ–					
1506/01	14:46239	Copy held by UB/TIB Hannover.			MF-000
IAEA-INFCIRC–					
193(Add.4)	14:44827	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636505/JAW	MF-000
361	14:44817	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636506/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
364	14:44818	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636512/JAW	MF-000
366	14:44819	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636507/JAW	MF-000
367	14:44828	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636508/JAW	MF-000
IAEA-SAR–					
5	14:45589	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635998/JAW	MF-000
IAEA-TECDOC–					
500	14:44625	NTIS (US Sales Only), PC A23/MF A01 - OSTI; INIS		DE89636254/JAW	MF-000
506	14:46240	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89635361/JAW	MF-000
512	14:45590	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89634686/JAW	MF-000
IBP-WB–					
8/1987	14:45359	Copy held by UB/TIB Hannover.			MF-000
IC–					
87/358(Rev.)	14:46636	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635692/JAW	MF-000
88/411	14:46637	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635693/JAW	MF-000
88/412	14:46585	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635748/JAW	MF-000
88/426	14:46682	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635828/JAW	MF-000
89/106	14:46495	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635718/JAW	MF-000
89/108	14:46496	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635719/JAW	MF-000
89/20	14:46453	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635921/JAW	MF-000
89/21	14:46621	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635907/JAW	MF-000
89/24	14:46586	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635749/JAW	MF-000
89/25	14:46587	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635750/JAW	MF-000
89/26	14:46588	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635751/JAW	MF-000
89/29	14:46589	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635763/JAW	MF-000
89/30	14:45841	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636426/JAW	MF-000
89/31	14:45842	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636427/JAW	MF-000
89/32	14:45843	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636428/JAW	MF-000
89/33	14:46384	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636298/JAW	MF-000
89/34	14:46056	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636294/JAW	MF-000
89/35	14:46638	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635702/JAW	MF-000
89/37	14:46590	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635752/JAW	MF-000
89/39	14:46622	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635908/JAW	MF-000
89/40	14:46639	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635703/JAW	MF-000
89/42	14:46640	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635704/JAW	MF-000
89/43	14:46454	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635929/JAW	MF-000
89/45	14:46623	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635909/JAW	MF-000
89/46	14:46641	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635694/JAW	MF-000
89/48	14:46642	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635695/JAW	MF-000
89/49	14:45527	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636232/JAW	MF-000
89/52	14:46492	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635720/JAW	MF-000
89/53	14:46643	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635696/JAW	MF-000
89/54	14:46644	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635697/JAW	MF-000
89/55	14:46645	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635698/JAW	MF-000
89/60	14:45632	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636072/JAW	MF-000
89/62	14:45557	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636239/JAW	MF-000
89/64	14:45469	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636210/JAW	MF-000
89/65	14:46493	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635721/JAW	MF-000
89/67	14:46646	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635699/JAW	MF-000
89/68	14:46484	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635733/JAW	MF-000
89/7	14:45840	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636429/JAW	MF-000
89/71	14:46494	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635722/JAW	MF-000
89/72	14:46647	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635700/JAW	MF-000
89/73	14:46648	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635705/JAW	MF-000
89/75	14:46591	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635786/JAW	MF-000
89/76	14:46592	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635764/JAW	MF-000
89/77	14:45470	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636213/JAW	MF-000
89/82	14:45594	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635999/JAW	MF-000
89/83	14:45595	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636000/JAW	MF-000
89/84	14:46649	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635701/JAW	MF-000
ICASE–					
89-1	14:45852	*See* N–89-22353			
89-18-PT-2	14:45742	*See* N–89-22837			
ICST–					
434053	14:45876	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
IDA-P–					
2142	14:46786	*See* AD-A–208034/9/XAB			
2145	14:46785	*See* AD-A–208033/1/XAB			

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IFSR–					
374	14:46679	*See* DOE/ET/53088–374			
385	14:46680	*See* DOE/ET/53088–385			
386	14:46681	*See* DOE/ET/53088–386			
IFT-TM–					
02/87	14:46369	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635901/JAW	MF-000
IKU-R–					
02.0786.00/03/88	14:44530	NTIS (US Sales Only), PC A04/MF A01		DE89914753/JAW	MF-000
02.0786.00/04/88	14:44531	NTIS (US Sales Only), PC A06/MF A01		DE89914754/JAW	MF-000
22.1864.00/02/88	14:44472	NTIS (US Sales Only), PC A03/MF A01		DE89914732/JAW	MF-000
24.1493.00/02/88	14:46353	NTIS (US Sales Only), PC A07/MF A01		DE89914755/JAW	MF-000
32.0326.00/01/88	14:45885	NTIS (US Sales Only), PC A05/MF A01		DE89914756/JAW	MF-000
34.2716.00/01/88	14:44532	NTIS (US Sales Only), PC A03/MF A01		DE89914745/JAW	MF-000
34.2780.00/01/88	14:44483	NTIS (US Sales Only), PC A03/MF A01		DE89914750/JAW	MF-000
34.2785.00/01/88	14:44484	NTIS (US Sales Only), PC A05/MF A01		DE89914733/JAW	MF-000
ILR-Mitt.–					
184(pt.1+2)/1987	14:44918	Technische Univ. Berlin (Germany, F.R.). Inst. fuer Luft- und Raumfahrt			ND-000
INA/NOGAP–					
8903	14:44464	NOGAP Secretariat, Constitutional Development and Strategic Planning Branch, Indian and Northern Affairs Canada, Les Terrasses de la Chaudiere, Ottawa, ON, CAN K1A 0H4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
INDC(CSR)–					
016/LJ	14:46551	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635977/JAW	MF-000
INDC(GDR)–					
054/LJ	14:46552	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635978/JAW	MF-000
INDC(NDS)–					
215/LJ	14:46553	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635979/JAW	MF-000
219/LNA	14:46777	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636509/JAW	MF-000
INFO–					
0055(Rev.1)	14:46782	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635654/JAW	MF-000
0210(E)(Rev.1)	14:45084	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635543/JAW	MF-000
0253-2	14:45050	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89635545/JAW	MF-000
0255	14:46294	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89636327/JAW	MF-000
INIS-BR–					
1558	14:46593	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635765/JAW	MF-000
1559	14:46370	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89635902/JAW	MF-000
1560	14:46594	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635766/JAW	MF-000
1561	14:45995	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89636479/JAW	MF-000
1562	14:46554	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635967/JAW	MF-000
1563	14:46555	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635968/JAW	MF-000
1564	14:46501	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635723/JAW	MF-000
1565	14:46556	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635969/JAW	MF-000
1566	14:46295	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89636315/JAW	MF-000
1567	14:46595	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635767/JAW	MF-000
1568	14:46557	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635980/JAW	MF-000
1569	14:46521	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635990/JAW	MF-000
1570	14:45959	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89636444/JAW	MF-000
1571	14:46650	NTIS (US Sales Only), PC A04/MF A01 - OSTI; INIS		DE89635706/JAW	MF-000
1572	14:46371	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89635903/JAW	MF-000
1573	14:46455	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635940/JAW	MF-000
1574	14:46571	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635964/JAW	MF-000
1575	14:45040	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636470/JAW	MF-000
1576	14:45051	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636473/JAW	MF-000
1577	14:45052	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636474/JAW	MF-000
1578	14:45844	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636430/JAW	MF-000
1579	14:45845	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636431/JAW	MF-000
1580	14:45846	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636432/JAW	MF-000
1581	14:45847	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636433/JAW	MF-000
1583	14:46596	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635768/JAW	MF-000
1584	14:46403	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635737/JAW	MF-000
1585	14:45596	NTIS (US Sales Only), PC A10/MF A01 - OSTI; INIS		DE89636058/JAW	MF-000
1587	14:46597	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89635769/JAW	MF-000
1588	14:46598	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635770/JAW	MF-000
1590	14:45597	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89636001/JAW	MF-000
1591	14:46599	NTIS (US Sales Only), PC A18/MF A01 - OSTI; INIS		DE89635771/JAW	MF-000
1592	14:45528	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89636233/JAW	MF-000

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1593	14:46404	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635736/JAW	MF-000
1594	14:45598	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89636002/JAW	MF-000
1595	14:46522	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635991/JAW	MF-000
1596	14:46600	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89635772/JAW	MF-000
1597	14:46683	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635829/JAW	MF-000
1598	14:46601	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635787/JAW	MF-000
1599	14:45996	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89636485/JAW	MF-000
1600	14:45471	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89636214/JAW	MF-000
1601	14:46405	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89635742/JAW	MF-000
1602	14:46406	NTIS (US Sales Only), PC A08/MF A01 - OSTI; INIS		DE89635738/JAW	MF-000
1603	14:45997	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89636480/JAW	MF-000
1604	14:45529	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89636230/JAW	MF-000
1605	14:45848	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89636434/JAW	MF-000
1606	14:45732	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89636142/JAW	MF-000
1607	14:46296	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89636302/JAW	MF-000
1608	14:44661	NTIS (US Sales Only), PC A06/MF A01 - OSTI; INIS		DE89636197/JAW	MF-000
1609	14:45472	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89636222/JAW	MF-000
1623	14:46713	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89635841/JAW	MF-000
INIS-SU–					
107/A	14:45640	NTIS (US Sales Only), PC A15/MF A01; INIS		DE89012208/JAW	MF-000
108	14:46685	NTIS (US Sales Only), PC A04/MF A01; INIS			MF-000
110/A	14:45736	NTIS (US Sales Only), PC A09/MF A01; INIS		DE89012209/JAW	MF-000
111/A	14:45451	NTIS (US Sales Only), PC A08/MF A01; INIS		DE89012207/JAW	MF-000
92	14:46602	NTIS (US Sales Only), PC A03/MF A01; INIS			MF-000
INIS-mf–					
11479	14:46212	NTIS (US Sales Only), PC A02/MF A01 - OSTI		DE89635255/JAW	MF-000
11490	14:46124	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635091/JAW	MF-000
11504	14:45599	NTIS (US Sales Only), PC A11/MF A01 - OSTI; INIS		DE89636003/JAW	MF-000
11505	14:45135	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636504/JAW	MF-000
11514	14:46427	NTIS (US Sales Only), PC A99/MF A01 - OSTI; INIS		DE89635911/JAW	MF-000
11527	14:46273	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636349/JAW	MF-000
11528	14:46274	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636350/JAW	MF-000
11530	14:46297	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636313/JAW	MF-000
11531	14:46298	NTIS (US Sales Only), PC A02/MF A01 - OSTI; INIS		DE89636314/JAW	MF-000
11951	14:46299	NTIS (US Sales Only), PC A03/MF A01		DE89910834/JAW	MF-000
11952	14:45473	NTIS (US Sales Only), PC A03/MF A01		DE89910835/JAW	MF-000
11983	14:45169	NTIS (US Sales Only), PC A03/MF A01		DE89910817/JAW	MF-000
11996	14:44725	NTIS (US Sales Only), PC A02/MF A01		DE89911508/JAW	MF-000
INPE–					
3849	14:46385	NTIS (US Sales Only), PC A07/MF A01 - OSTI; INIS		DE89636299/JAW	MF-000
IPEN-PUB–					
234	14:46270	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636401/JAW	MF-000
235	14:45530	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636235/JAW	MF-000
236	14:44726	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636495/JAW	MF-000
237	14:44727	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636496/JAW	MF-000
238	14:44728	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636493/JAW	MF-000
239	14:44729	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636497/JAW	MF-000
240	14:44730	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636498/JAW	MF-000
241	14:46145	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636251/JAW	MF-000
242	14:44731	NTIS (US Sales Only), PC A05/MF A01 - OSTI; INIS		DE89636494/JAW	MF-000
243	14:45999	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636486/JAW	MF-000
244	14:45479	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636211/JAW	MF-000
245	14:45620	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636052/JAW	MF-000
246	14:45041	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636471/JAW	MF-000
247	14:45531	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636225/JAW	MF-000
248	14:45737	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636143/JAW	MF-000
249	14:46511	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635987/JAW	MF-000
250	14:46271	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636376/JAW	MF-000
IPPJ-T–					
37	14:46714	NTIS (US Sales Only), PC A18/MF A01		DE89906613/JAW	MF-000
ISI-B–					
16-88	14:44894	Copy held by UB/TIB Hannover.			MF-000
ISPG–					
85-28	14:46344	Canadian Government Publishing Centre, Supply and Services Canada, Ottawa, ON, CAN K1A 0S9; $14.00; OTHER COUNTRIES: $16.80 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

ISPG–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
8502	14:44620	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
IVL-B–					
922	14:46078	NTIS (US Sales Only), PC A04/MF A01		DE89914804/JAW	MF-000
IVO-A–					
03/89	14:45008	NTIS (US Sales Only), PC A04/MF A01		DE89787752/JAW	MF-000
JAERI-M–					
89-012	14:46759	NTIS (US Sales Only), PC A10/MF A01		DE89906455/JAW	MF-000
JY/YTK-TIED–					
129	14:44446	NTIS (US Sales Only), PC A04/MF A01		DE89787751/JAW	MF-000
Juel–					
2254	14:46018	NTIS (US Sales Only), PC A09/MF A01		DE89914976/JAW	MF-000
2266	14:45043	NTIS (US Sales Only), PC A05/MF A01		DE89915124/JAW	MF-000
Juel-Spez–					
473	14:45360	NTIS (US Sales Only), PC A13/MF A01		DE89914839/JAW	MF-000
487	14:45136	NTIS (US Sales Only), PC A11/MF A01		DE89914975/JAW	MF-000
502	14:46079	NTIS (US Sales Only), PC A05/MF A01		DE89915136/JAW	MF-000
K/QT–					
297	14:44662	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016532/JAW	MF-517
KAPL–					
4701	14:45480	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015211/JAW	PC-504
KCP–					
613-4076	14:45865	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014010/JAW	PC-706
613-4080	14:45481	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014011/JAW	PC-706
613-4081	14:45866	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014012/JAW	PC-706
613-4082	14:45482	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014013/JAW	PC-706
613-4096	14:45621	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015205/JAW	PC-701
613-4100	14:45859	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015206/JAW	PC-706
613-4113	14:45559	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015749/JAW	MF-701
KFK–					
4561	14:45483	NTIS (US Sales Only), PC A04/MF A01		DE89915150/JAW	MF-000
4564	14:46517	NTIS (US Sales Only), PC A03/MF A01		DE89915143/JAW	MF-000
4565	14:46558	NTIS (US Sales Only), PC A03/MF A01		DE89915122/JAW	MF-000
4573	14:45532	NTIS (US Sales Only), PC A03/MF A01		DE89915149/JAW	MF-000
4584	14:46518	NTIS (US Sales Only), PC A03/MF A01		DE89915144/JAW	MF-000
4588	14:46715	NTIS (US Sales Only), PC A05/MF A01		DE89915168/JAW	MF-000
KFKI–					
1989-18/A	14:46559	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635970/JAW	MF-000
1989-21/C	14:46373	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635843/JAW	MF-000
1989-22/A	14:46472	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635938/JAW	MF-000
1989-26/A	14:46560	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635984/JAW	MF-000
KO–					
297-89	14:46352	*See* EGG–10617-6065			
KTM/E-D–					
169	14:45361	NTIS (US Sales Only), PC A06/MF A01		DE89787743/JAW	MF-000
170	14:45362	NTIS (US Sales Only), PC A08/MF A01		DE89787744/JAW	MF-000
171	14:45175	NTIS (US Sales Only), PC A06/MF A01		DE89787741/JAW	MF-000
LA–					
11511-MS	14:44732	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016020/JAW	MF-702
11605-MS	14:44733	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016019/JAW	MF-814
11647-MS	14:44970	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015208/JAW	MF-251
11656-MS	14:46519	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015976/JAW	MF-700
LA-SUB–					
89-1	14:46061	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016311/JAW	MF-905
LA-UR–					
88-3161	14:46027	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89000356/JAW	MF-741
89-1127	14:45560	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009252/JAW	MF-404
89-1833	14:45760	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012632/JAW	MF-706
89-1939	14:44734	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014262/JAW	MF-711
89-2027	14:46739	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014315/JAW	MF-400
89-2112	14:46019	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014226/JAW	MF-706
89-2170	14:45691	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014278/JAW	MF-000
89-2178	14:44664	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015274/JAW	MF-700
89-2246	14:46374	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015241/JAW	MF-706
89-2337	14:45725	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015267/JAW	MF-701
89-2403	14:45441	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015258/JAW	MF-701
89-2429	14:46418	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015252/JAW	MF-405
89-2446	14:46407	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015250/JAW	MF-700
89-2453	14:46408	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015248/JAW	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-2456	14:46196	NTIS, PC A02/MF A01 - OSTI		DE89015247/JAW	MF-405
89-2459	14:45484	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015304/JAW	MF-706
89-2489	14:46716	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015297/JAW	MF-420
89-2505	14:46561	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015295/JAW	MF-413
89-2517	14:46375	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015293/JAW	MF-700
89-2541	14:44735	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015288/JAW	MF-814;MN-401
89-2561	14:45692	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015282/JAW	MF-701
89-2564	14:46629	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015281/JAW	MF-706
89-2573	14:44736	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015278/JAW	MF-814
89-2618	14:46197	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016605/JAW	MF-705
89-2656	14:46652	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016991/JAW	MF-706
89-2691	14:45533	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016773/JAW	MF-000
89-2701	14:45485	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016770/JAW	MF-000
89-2706	14:46760	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016769/JAW	MF-905
89-2716	14:46031	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016996/JAW	MF-741
89-2723	14:46032	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016587/JAW	MF-741
89-2724	14:46409	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016588/JAW	MF-910
89-2734	14:46033	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016595/JAW	MF-706
89-2756	14:46437	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016586/JAW	MF-413
89-2782	14:46717	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016980/JAW	MF-712
89-2790	14:46562	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016977/JAW	MF-413
89-2791	14:46034	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016772/JAW	MF-742
89-2792	14:45960	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016976/JAW	MF-000
89-2795	14:45933	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016975/JAW	MF-414
89-2798	14:46410	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016974/JAW	MF-411
89-2800	14:46419	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016973/JAW	MF-705
89-2818	14:45486	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016816/JAW	MF-741
89-2825	14:46376	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016988/JAW	MF-910
89-2899	14:46688	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016611/JAW	MF-910
89-2920	14:44830	NTIS, PC A99/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016602/JAW	MF-410
89-2929	14:45534	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016969/JAW	MF-404
89-2938	14:45834	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016729/JAW	MF-000
89-2960	14:46438	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016777/JAW	MF-414
89-2967	14:45487	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016782/JAW	MF-704
89-376	14:46028	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007748/JAW	MF-741
89-407	14:46029	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007744/JAW	MF-741
89-602	14:46030	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008415/JAW	MF-741
LAIR–					
373	14:46337	*See* AD-A-207945/7/XAB			
LBL–					
24965	14:45363	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015384/JAW	MF-350
25981	14:46202	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016025/JAW	MF-408;MN-405
26513	14:45693	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015226/JAW	MF-404
26601	14:46761	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016303/JAW	MF-405
26734	14:46020	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015339/JAW	MF-404
26824	14:45961	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015968/JAW	MF-414
26924	14:45293	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016571/JAW	MF-101
26935	14:45488	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011819/JAW	MF-404
27205	14:46203	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016317/JAW	MF-408
27213	14:45364	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015341/JAW	MF-350
27356	14:45489	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016306/JAW	MF-404
27362	14:45365	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016313/JAW	MF-350
27436	14:46062	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016339/JAW	MF-405;MN-402
27448	14:46309	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015335/JAW	MF-408
27454	14:46563	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016338/JAW	MF-413;MN-405
27496	14:45916	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016046/JAW	MF-414
27498	14:45490	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016302/JAW	MF-404
LBL-PUB–					
657/6-89	14:46204	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016316/JAW	MF-408
LNCC–					
018/88	14:46653	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635708/JAW	MF-000
019/88	14:46654	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635709/JAW	MF-000
021/88	14:46655	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635710/JAW	MF-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
022/88	14:46656	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635711/JAW	MF-000
030/88	14:45849	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636435/JAW	MF-000
033/88	14:46657	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635712/JAW	MF-000
034/88	14:45850	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636436/JAW	MF-000
035/88	14:46420	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635910/JAW	MF-000
036/88	14:46658	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89635713/JAW	MF-000
037/88	14:45851	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636437/JAW	MF-000
ME–					
88	14:45294	Maritime Electric Co. Ltd., Confederation Court Mall, 134 Kent St., Charlottetown, PE, CAN C1A 7N2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MEA–					
2354	14:45491	*See* NUREG/CR–5388			
MEM–					
GP83-1	14:44508	Manitoba Dept. of Energy and Mines, Legislative Bldg., Room 301, Winnipeg, MB, CAN R3C 0V8; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MHD-ITC–					
89-126	14:45313	*See* DOE/PC/90274–T4			
MICROLOG–					
87-00599	14:45454	*See* CANMET–4-9056			
87-00599	14:45506	*See* WIC–7-184-071-099			
87-01191	14:45411	*See* EMR/MS–8602			
87-02651	14:46135	*See* CPS–EPS9/HA/1			
87-02652	14:46136	*See* CPS–SPE9/HA/1			
87-02816	14:44878	*See* EC/IWD–1987YNT			
87-02884	14:45222	*See* NEB-SS–BT31-2-1988-III-14			
87-02901	14:45225	*See* NPA–BT31-2-1988-III-31			
87-02958	14:44877	*See* EC/IWD–1987BC			
87-02963	14:45393	*See* MU/CRT–495			
87-03480	14:44876	*See* EC/IWD–1987A			
87-03780	14:44898	*See* PNFI–PI-X-59F			
87-03893	14:46088	*See* OE/ARB–ARB-052-87			
87-04003	14:45459	*See* CU/FE–87-04003			
87-04650	14:46170	*See* FO–1987			
87-04835	14:46344	*See* ISPG–85-28			
87-05001	14:45368	*See* NRC–1989			
87-05010	14:45367	*See* NRC–1989			
87-05971	14:44508	*See* MEM–GP83-1			
87-06101	14:46168	*See* EC/Q/CP–8703			
88-06244	14:46357	*See* EC/NHR/S–87004			
89-00772	14:44839	*See* MWL–8703			
89-00772	14:44840	*See* MWL–8703			
89-02021	14:45881	*See* CRA–W62-11-88-8-9E			
89-02022	14:45882	*See* DNV/C–W62-11-88-2E			
89-02022	14:45884	*See* DNV/C–W62-11-88-11-1E			
89-02031	14:45880	*See* CMEL–W62-11-88-5-2E			
89-02042	14:45883	*See* DNV/C–W62-11-88-6E			
89-02129	14:46161	*See* OME/WRB–DR84-2			
89-02194	14:44879	*See* EC/IWD–1988A			
89-02221	14:46319	*See* ACOH/SD–1988			
89-02237	14:46087	*See* OE/ARB–056-88-ARSP			
89-02261	14:46160	*See* OME–APIOS-1988			
89-02335	14:44880	*See* EC/IWD–1988YNT			
89-02358	14:44887	*See* MNR/FB–88-13			
89-02359	14:46155	*See* MNR/FB–88-12			
89-02370	14:45416	*See* OTIFBI–1987			
89-02382	14:45445	*See* EC/RRE–1989			
89-02399	14:44522	*See* RER–092			
89-02439	14:44512	*See* ER/C–098			
89-02451	14:46123	*See* ETDE/CA-MS–102			
89-02543	14:46090	*See* OH/RD–88-162-K			
89-02552	14:45413	*See* OH/RD–88-52-K			
89-02554	14:46089	*See* OH/RD–88-145-K			
89-02573	14:45298	*See* OH/RD–88-93-K			
89-02574	14:45016	*See* OH/RD–88-96-K			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-02576	14:45015	*See* OH/RD–88-68-K			
89-02580	14:45415	*See* OH/RD–88-81-K			
89-02589	14:44884	*See* OH/RD–88-7-K			
89-02594	14:45012	*See* OH/RD–87-310-K			
89-02597	14:45623	*See* OH/RD–88-29-K			
89-02598	14:45013	*See* OH/RD–88-28-K			
89-02600	14:46339	*See* OH/RD–88-121-K			
89-02602	14:45014	*See* OH/RD–88-49-K			
89-02604	14:45860	*See* OH/RD–88-2-K			
89-02605	14:45000	*See* OH/RD–87-309-K			
89-02606	14:44883	*See* OH/RD–88-6-K			
89-02612	14:46023	*See* OH/RD–88-41-K			
89-02616	14:44882	*See* OH/RD–87-329-K			
89-02620	14:45011	*See* OH/RD–87-305-K			
89-02626	14:45858	*See* EMR/MTL–89-02			
89-02635	14:45876	*See* ICST–434053			
89-02642	14:45414	*See* OH/RD–88-74-K			
89-02648	14:44986	*See* OH/RD–87-314-K			
89-02649	14:44994	*See* OH/RD–87-315-K			
89-02653	14:44999	*See* OH/RD–87-158-K			
89-02654	14:45010	*See* OH/RD–87-4-K			
89-02656	14:45370	*See* OH/RD–87-177-K			
89-02671	14:45009	*See* OH/R–88-124-K			
89-02697	14:44464	*See* INA/NOGAP–8903			
89-02710	14:45372	*See* OH/RD–88-57-K			
89-02711	14:45371	*See* OH/RD–88-42-K			
89-02716	14:45185	*See* SF–8903			
89-02719	14:44838	*See* CERI–29			
89-02765	14:45305	*See* EFG–1988			
89-02776	14:45221	*See* EF–1988			
89-02809	14:45301	*See* SPC–1988			
89-02837	14:46342	*See* GS–89-1H			
89-02878	14:45324	*See* BLRL–8808			
89-02879	14:44860	*See* CNBA–8711			
89-02883	14:45432	*See* BLRL–8804			
89-02884	14:45431	*See* BLRL–8804			
89-02885	14:44864	*See* NBNRE–8810			
89-02971	14:44992	*See* MSC–X7801/1			
89-02994	14:45294	*See* ME–88			
89-02996	14:45210	*See* ENR/SE–1988			
89-03051	14:44885	*See* SARE–M91-7-43-1989E			
89-03052	14:45398	*See* AC/ESRI–1-944			
89-03076	14:45433	*See* CNBA–1988			
89-03114	14:45297	*See* OEB–HR-17			
89-03117	14:44976	*See* ETDE/CA-MS–M91-7-28-1988E			
89-03119	14:44621	*See* TU/CEA–19881			
89-03119	14:44622	*See* TU/CEA–19882			
89-03120	14:44496	*See* SRC/PD–P-110-82-E-88			
89-03163	14:45236	*See* PMA–1988/1-6			
89-03165	14:45284	*See* HQ–1988			
89-03170	14:44995	*See* OH/RD–D88-0010			
89-03179	14:45285	*See* HQ–8903			
89-03249	14:45564	*See* NRCC/IMR–29453			
89-03256	14:46022	*See* NRC–29808			
89-03274	14:46189	*See* UW/GLI–EN57-27-1987-03			
89-03296	14:46021	*See* NRC–27703			
89-03340	14:46156	*See* MNR/FB–88-15			
89-03584	14:45223	*See* NEB–SSBT31-2-1990-III-14			
89-03655	14:44511	*See* CPS–EE-113			
89-03657	14:44513	*See* FTC–EE-112			
89-03778	14:44462	*See* CPA–1988			
89-03779	14:45235	*See* GOGLA–8902			
89-03792	14:44613	*See* NPA–C88-1-1988			
89-03799	14:45224	*See* NEB–SS-NE1-1988E			
89-03873	14:45189	*See* EC/CPG–8902			
89-04011	14:45396	*See* OTC–1988			
89-04110	14:45296	*See* NLH–1988			
MISC–					
89028	14:45444	*See* DOE/ID–10232			
89076	14:44704	*See* DOE/ID–22080			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
MLM–					
3603	14:46609	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016958/JAW	PC-704
MNR/FB–					
88-12	14:46155	Manitoba Natural Resources, Public Information Services, 1495 St. James St., PO Box 22, Winnipeg, MB, CAN R3H 0W9; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-13	14:44887	Manitoba Natural Resources, Public Information Services, 1495 St. James St., PO Box 22, Winnipeg, MB, CAN R3H 0W9; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-15	14:46156	Manitoba Natural Resources, Public Information Services, 1495 St. James St., PO Box 22, Winnipeg, MB, CAN R3H 0W9; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MRP/MSL–					
84-147(IR)	14:45622	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636019/JAW	MF-000
MSC–					
X7801/1	14:44992	British Columbia Legislative Library, Government Documents Division, Parliament Buildings, Victoria, BC, CAN V8V 1X4; $65.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MU/CRT–					
495	14:45393	Centre de recherche sur les transports, Universite de Montreal, CP 6128, Succursale A, Montreal, PQ, CAN H3C 3J7; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
MWL–					
8703	14:44839	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
8703	14:44840	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
N–					
89-16917	14:44895	NTIS, PC A03/MF A01			ND-00
89-16965	14:46377	NTIS, PC A04/MF A01			ND-00
89-21895	14:45535	NTIS, PC A03/MF A01			ND-00
89-22053	14:45741	NTIS, PC A03/MF A01			ND-00
89-22177	14:44896	NTIS, PC A02/MF A01			ND-00
89-22353	14:45852	NTIS, PC A03/MF A01			ND-00
89-22545	14:46378	NTIS, PC A03/MF A01			ND-00
89-22651	14:44897	NTIS, PC A02/MF A01			ND-00
89-22652	14:45761	NTIS, PC A03/MF A01			ND-00
89-22684	14:45561	NTIS, PC A03/MF A01			ND-00
89-22709	14:46421	NTIS, PC A03/MF A01			ND-00
89-22710	14:45164	NTIS, PC A02/MF A01			ND-00
89-22837	14:45742	NTIS, PC A03/MF A01			ND-00
89-22850	14:45762	NTIS, PC A02/MF A01			ND-00
89-22891	14:45763	NTIS, PC A20/MF A01			ND-00
89-22919	14:45764	NTIS, PC A02/MF A01			ND-00
89-22940	14:45765	NTIS, PC A17/MF A01; also available from COSMIC, Athens, GA 30602			ND-00
89-22982	14:45163	NTIS, PC A03/MF A01			ND-00
89-23184	14:46762	NTIS, PC A03/MF A01			ND-00
89-23300	14:46718	NTIS, PC A03/MF A01			ND-00
89-23302	14:45562	NTIS, PC A04/MF A01			ND-00

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-23399	14:46001	NTIS, PC A04/MF A01			ND-00
89-23400	14:45563	NTIS, PC A05/MF A01			ND-00
NAS–					
1.15:101422	14:44895	*See* N–89-16917			
1.15:101456	14:45535	*See* N–89-21895			
1.15:101969	14:45764	*See* N–89-22919			
1.15:101970	14:44896	*See* N–89-22177			
1.15:101984	14:45561	*See* N–89-22684			
1.15:101997	14:45164	*See* N–89-22710			
1.15:102013	14:45741	*See* N–89-22053			
1.15:102020	14:44897	*See* N–89-22651			
1.15:102039	14:45761	*See* N–89-22652			
1.15:102190	14:45762	*See* N–89-22850			
1.26:181768	14:46718	*See* N–89-23300			
1.26:181770	14:45852	*See* N–89-22353			
1.26:181815	14:45742	*See* N–89-22837			
1.26:183330	14:46378	*See* N–89-22545			
1.26:184771	14:46377	*See* N–89-16965			
1.26:184835	14:45563	*See* N–89-23400			
1.26:184836	14:46421	*See* N–89-22709			
1.26:184842	14:45562	*See* N–89-23302			
1.26:184910	14:46001	*See* N–89-23399			
1.26:184938	14:46762	*See* N–89-23184			
1.55:10029	14:45163	*See* N–89-22982			
1.55:3026	14:45763	*See* N–89-22891			
1.55:3029	14:45765	*See* N–89-22940			
NASA-CP–					
10029	14:45163	*See* N–89-22982			
3026	14:45763	*See* N–89-22891			
3029	14:45765	*See* N–89-22940			
NASA-CR–					
181768	14:46718	*See* N–89-23300			
181770	14:45852	*See* N–89-22353			
181815	14:45742	*See* N–89-22837			
183330	14:46378	*See* N–89-22545			
184771	14:46377	*See* N–89-16965			
184835	14:45563	*See* N–89-23400			
184836	14:46421	*See* N–89-22709			
184842	14:45562	*See* N–89-23302			
184910	14:46001	*See* N–89-23399			
184938	14:46762	*See* N–89-23184			
NASA-TM–					
101422	14:44895	*See* N–89-16917			
101456	14:45535	*See* N–89-21895			
101969	14:45764	*See* N–89-22919			
101970	14:44896	*See* N–89-22177			
101984	14:45561	*See* N–89-22684			
101997	14:45164	*See* N–89-22710			
102013	14:45741	*See* N–89-22053			
102020	14:44897	*See* N–89-22651			
102039	14:45761	*See* N–89-22652			
102190	14:45762	*See* N–89-22850			
NASA/CR–					
182127	14:45437	*See* DOE/NASA–0168-11			
NBI-HE–					
89-24	14:46504	NTIS (US Sales Only), PC A03/MF A01		DE89915283/JAW	MF-000
89-25	14:46659	NTIS (US Sales Only), PC A03/MF A01		DE89915282/JAW	MF-000
89-26	14:46473	NTIS (US Sales Only), PC A03/MF A01		DE89915284/JAW	MF-000
NBL–					
321	14:44820	NTIS, PC A14/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016064/JAW	MF-515
NBNRE–					
8810	14:44864	New Brunswick Legislative Library, Government Documents Section, 766 King Street, Fredericton, NB, CAN E3B 5H1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

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NBNRE/FW–					
006U192	14:44993	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NBSIR–					
88-3739	14:45366	OSTI		TI89015518/JAW	MF-350
NEB–					
SS-NE1-1988E	14:45224	National Energy Board, Regulatory Support Office, 473 Albert Street, Ottawa, Ont., CAN K1A 0E5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SSBT31-2-1990-III-14	14:45223	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $4.00; OTHER COUNTRIES: $4.80 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NEB-SS–					
BT31-2-1988-III-14	14:45222	National Energy Board, Trebla Bldg., 473 Albert St., Ottawa, ON, CAN K1A 0E5; $4.00; OTHER COUNTRIES: $4.80 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NEI-DK–					
180	14:44931	NTIS (US Sales Only), PC A03/MF A01		DE89914636/JAW	MF-000
181	14:44869	NTIS (US Sales Only), PC A06/MF A01		DE89914637/JAW	MF-000
185	14:44934	NTIS (US Sales Only), PC A03/MF A01		DE89914642/JAW	MF-000
186	14:44889	NTIS (US Sales Only), PC A05/MF A01		DE89914643/JAW	MF-000
187	14:44935	NTIS (US Sales Only), PC A03/MF A01		DE89914644/JAW	MF-000
188	14:45743	NTIS (US Sales Only), PC A06/MF A01		DE89914645/JAW	MF-000
189	14:45194	NTIS (US Sales Only), PC A03/MF A01		DE89914660/JAW	MF-000
190	14:45886	NTIS (US Sales Only), PC A03/MF A01		DE89914662/JAW	MF-000
192	14:44485	NTIS (US Sales Only), PC A08		DE89914663/JAW	MF-000
196	14:45424	NTIS (US Sales Only), PC A03/MF A01		DE89914672/JAW	MF-000
200	14:44936	NTIS (US Sales Only), PC A04/MF A01		DE89914673/JAW	MF-000
201	14:44939	NTIS (US Sales Only), PC A08/MF A01		DE89914677/JAW	MF-000
202	14:44971	NTIS (US Sales Only), PC A07/MF A01		DE89914690/JAW	MF-000
NEI-FI–					
74	14:44407	NTIS (US Sales Only), PC A03/MF A01		DE89787738/JAW	MF-000
NEI-NO–					
66	14:44489	NTIS (US Sales Only), PC A12/MF A01		DE89914739/JAW	MF-000
67	14:44490	NTIS (US Sales Only), PC A15/MF A01		DE89914768/JAW	MF-000
68	14:44473	NTIS (US Sales Only), PC A13/MF A01		DE89914769/JAW	MF-000
69	14:44527	NTIS (US Sales Only), PC A15/MF A01		DE89914774/JAW	MF-000
70	14:44491	NTIS (US Sales Only), PC A18/MF A01		DE89914770/JAW	MF-000
91	14:44514	NTIS (US Sales Only), PC A12/MF A01		DE89914775/JAW	MF-000
92	14:45195	NTIS (US Sales Only), PC A03/MF A01		DE89914783/JAW	MF-000
NEI-SE–					
42	14:45295	NTIS (US Sales Only), PC A03/MF A01		DE89914798/JAW	MF-000
NG–					
18-179	14:45453	*See* AGA–9015609			
NILU-F–					
6/88	14:46080	NTIS (US Sales Only), PC A03/MF A01		DE89914748/JAW	MF-000
NIST/TN–					
1259	14:46788	*See* PB–89-209357/XAB			
NISTIR–					
89/4049	14:46045	*See* PB–89-200208/XAB			
NLH–					
1988	14:45296	Newfoundland and Labrador Hydro, Philip Pl., Elizabeth Ave., St. John's, NF, CAN A1A 2X8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NOAA-TM-ERL-ARL–					
170	14:46097	*See* PB–89-194294/XAB			
NOAA-TR-NMFS–					
76	14:45104	*See* PB–89-190235/XAB			

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NPA–					
BT31-2-1988-III-31	14:45225	Northern Pipeline Agency, Lester B. Pearson Building, 125 Sussex Drive, Ottawa, ON, CAN K1A 0G2; $3.00; OTHER COUNTRIES: $3.60 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
C88-1-1988	14:44613	Northern Pipeline Agency, Lester B. Pearson Building, 125 Sussex Drive, Ottawa, ON, CAN K1A 0G2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NRC–					
1989	14:45367	Ontario Ministry of Tourism and Recreation, Communications Branch, Customer Sales & Service Section, 77 Bloor St., W., Toronto, ON, CAN M7A 2R9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
1989	14:45368	Ontario Ministry of Tourism and Recreation, Communications Branch, Customer Sales & Service Section, 77 Bloor St., W., Toronto, ON, CAN M7A 2R9; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
27703	14:46021	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
29808	14:46022	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NRCC/IMR–					
29453	14:45564	National Research Council of Canada, Publication Sales and Distribution Office, Montreal Road, Ottawa, ON, CAN K1A 0R6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
NRL-MR–					
6431	14:46042	*See* AD-A–207880/6/XAB			
6438	14:46664	*See* AD-A–207975/4/XAB			
NRPB-GS–					
10	14:46310	H.M. Stationery Office, London, price Pound 5.00			ND-000
NSF–					
89-1	14:45198	*See* PB–89-195382/XAB			
NSR–					
41/89-0721	14:45526	*See* DOE/SF/17169–T13			
NSS/G–					
103	14:46146	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636252/JAW	MF-000
NSS/R–					
134	14:44737	NTIS (US Sales Only), PC A03/MF A01 - OSTI; INIS		DE89636499/JAW	MF-000
137	14:46114	NTIS (US Sales Only), PC A18/MF A01 - OSTI; INIS		DE89636295/JAW	MF-000
NUKEM-FuE–					
88039	14:44738	NTIS (US Sales Only), PC A07/MF A01		DE89915148/JAW	MF-000
NUREG–					
0325-Rev.12	14:46740	NTIS, PC A04/MF A01 - GPO - OSTI		TI89016381/JAW	MF-000
0713-Vol.8	14:45137	NTIS, PC A11/MF A01 - GPO - OSTI		TI89016374/JAW	MF-000
0750-Vol.29-No.6	14:45053	NTIS, PC A06/MF A01 - GPO; OSTI; INIS		TI89015601/JAW	MF-000
0991-Suppl.8	14:45138	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI89014476/JAW	MF-000
1336-Rev.1	14:45054	NTIS, PC A07/MF A01 - GPO; OSTI; INIS		TI89016043/JAW	MF-000
1337-Rev.1	14:45055	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI89016042/JAW	MF-000
NUREG/CR–					
2331-Vol.9-No.1	14:45152	NTIS, PC A08/MF A01 - GPO - OSTI		TI89016045/JAW	MF-000
4667-Vol.6	14:45025	NTIS, PC A04/MF A01 - GPO - OSTI		TI89015614/JAW	MF-000
4744-Vol.2-No.2	14:45071	NTIS, PC A04/MF A01 - GPO; OSTI; INIS		TI89016842/JAW	MF-000

NUREG/CR–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
4918-Vol.3	14:44758	NTIS, PC A03/MF A01 - GPO - OSTI		TI89016237/JAW	MF-000
5155	14:45103	NTIS, PC A06/MF A01 - GPO - OSTI		TI89016499/JAW	MF-000
5287	14:45026	NTIS, PC A03/MF A01 - GPO - OSTI		TI89016307/JAW	MF-000
5290	14:45082	NTIS, PC A03/MF A01 - GPO - OSTI		TI89016026/JAW	MF-000
5322	14:45027	NTIS, PC A03/MF A01 - GPO - OSTI		TI89016238/JAW	MF-000
5367	14:44759	NTIS, PC A06/MF A01 - GPO - OSTI		TI89016246/JAW	MF-000
5388	14:45491	NTIS, PC A09/MF A01 - GPO - OSTI		TI89015595/JAW	MF-000
5426	14:44760	NTIS, PC A05/MF A01 - GPO; OSTI; INIS		TI89016813/JAW	MF-000
OCS/MMS–					
85/0105	14:44520	*See* PB–89-204648/XAB			
OE/ARB–					
056-88-ARSP	14:46087	Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ARB-052-87	14:46088	Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OEB–					
HR-17	14:45297	Publications Ontario, 880 Bay St., 5th Floor, Toronto, ON, CAN M7A 1N8; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OH/R–					
88-124-K	14:45009	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $10.00 CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OH/RD–					
78-97	14:45369	Canadian Electrical Association, Research & Development, Suite #500, One Westmount Square, Montreal, PQ, CAN H3Z 2P9; $75.00 NON-MEMBERS; MEMBERS: PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-158-K	14:44999	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-177-K	14:45370	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-305-K	14:45011	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-309-K	14:45000	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-310-K	14:45012	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
87-314-K	14:44986	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-315-K	14:44994	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-329-K	14:44882	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
87-4-K	14:45010	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-121-K	14:46339	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-145-K	14:46089	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-162-K	14:46090	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-2-K	14:45860	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-28-K	14:45013	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-29-K	14:45623	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C/ CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-41-K	14:46023	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-42-K	14:45371	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-49-K	14:45014	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-52-K	14:45413	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
OH/RD–					
88-57-K	14:45372	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-6-K	14:44883	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-68-K	14:45015	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-7-K	14:44884	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-74-K	14:45414	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-81-K	14:45415	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-93-K	14:45298	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
88-96-K	14:45016	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
D88-0010	14:44995	Ontario Hydro Research Division, Records Clerk, Bldg. KR 107, 800 Kipling Ave., Etobicoke, ON, CAN M8Z 5S4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OME–					
APIOS-1988	14:46160	Ministry of the Environment. A.P.I.O.S. Coordination Office, 40 St. Clair Avenue West, 7th Floor, Toronto, ON, CAN M4V 1M2; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OME/WRB–					
DR84-2	14:46161	Ontario Ministry of the Environment, Public Information Office, 135 St. Clair Ave. West, Toronto, ON, CAN M4V 1P5; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ONRL–					
8-016-R	14:45536	NTIS, PC A05/MF A01			ND-00
OPI–					
1989	14:44465	Ontario Petroleum Institute, Inc., 70 Talbot Road South, Box 340, Lambeth, ON, CAN N0L 1S0; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
ORAU–					
88/F-111	14:46311	Oak Ridge Associated Univ., Office of Information Services, P.O. Box 117, Oak Ridge, TN 37831-0117			ND-408

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
ORNL–					
6526/R5	14:46138	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015683/JAW	MF-402
6526/R6	14:46139	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015684/JAW	MF-630
6540/V2	14:45196	NTIS, PC A12/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015686/JAW	MF-400
6545	14:46198	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015644/JAW	PC-408
6549	14:45394	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015670/JAW	MF-330
6561	14:46529	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015682/JAW	MF-413
6562	14:44424	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015669/JAW	MF-101
ORNL/CON–					
285	14:45299	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015688/JAW	MF-350
286	14:45373	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015689/JAW	MF-350
288	14:45300	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015690/JAW	MF-350
ORNL/CSD/TM–					
250	14:45769	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016891/JAW	MF-000
ORNL/FMP–					
89/1	14:45492	NTIS, PC A99/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015665/JAW	MF-114
89/3	14:44425	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015668/JAW	MF-114
ORNL/FTR–					
2820	14:46719	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017301/JAW	MF-423
2839	14:46720	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017284/JAW	MF-423
2911	14:46512	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017277/JAW	MF-413
2990	14:45934	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017279/JAW	MF-411
3064	14:46411	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017275/JAW	MF-410
3191	14:46513	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017353/JAW	MF-413
3218	14:45835	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017352/JAW	MF-414
3253	14:46412	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017293/JAW	MF-401
3330	14:45374	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015953/JAW	MF-350
3338	14:45493	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016874/JAW	MF-404
3342	14:46363	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016157/JAW	MF-402
3344	14:46326	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016271/JAW	MF-408
3347	14:45056	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015598/JAW	MF-520
3351	14:45537	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016899/JAW	MF-401
ORNL/M–					
863	14:45375	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015654/JAW	MF-350
907	14:45376	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015657/JAW	MF-350
916	14:45395	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015667/JAW	MF-330
ORNL/RASA–					
88/17	14:46147	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016235/JAW	MF-511
88/57	14:46148	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016038/JAW	MF-511
88/81	14:46149	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017336/JAW	MF-511
88/82	14:46150	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017338/JAW	MF-511
88/83	14:46151	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017335/JAW	MF-511
88/99	14:46152	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89017337/JAW	MF-511
ORNL/Sub–					
86-SA578/1	14:45377	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015646/JAW	PC-350
89-SC924/2	14:44761	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015663/JAW	MF-721
ORNL/TM–					
10724	14:46140	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015653/JAW	MF-603
10902	14:45028	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015645/JAW	PC-812
10906	14:44762	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015652/JAW	MF-721
10940	14:44763	NTIS, PC A05/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015651/JAW	MF-800
10995	14:46787	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015649/JAW	MF-705
11053	14:45538	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015680/JAW	MF-373
11065	14:46091	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015679/JAW	MF-402
11072	14:45027	*See* NUREG/CR–5322			
11125	14:45378	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015675/JAW	MF-000
11155	14:45197	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015671/JAW	MF-400
11158	14:45494	NTIS, PC A12/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015656/JAW	PC-423
11184	14:46092	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014004/JAW	MF-400
11230	14:45448	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016935/JAW	MF-334
11234	14:44831	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016936/JAW	MF-400
11238	14:45770	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016937/JAW	MF-506
11252	14:46172	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016938/JAW	MF-402;MN-407
11257	14:46474	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016939/JAW	MF-414
11297	14:46565	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016941/JAW	MF-413
9179/R2	14:46564	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015659/JAW	MF-414

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
OTC–					
1988	14:45396	Ministry of Transportation. Transportation Technology and Energy Branch, 1201 Wilson Ave., Downsview, ON, CAN M3M 1J8; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OTIFBI–					
1987	14:45416	Canada Dept. of Fisheries and Oceans, Scientific Publications, 200 Kent St., 14th Floor, Ottawa, ON, CAN K1A 0E6; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
OUP–					
88-24	14:44932	NTIS (US Sales Only), PC A03/MF A01		DE89914787/JAW	MF-000
OY/PSTL-RR–					
93	14:44870	NTIS (US Sales Only), PC A06/MF A01		DE89787749/JAW	MF-000
OY/PSTL-TIED–					
62	14:44460	NTIS (US Sales Only), PC A03/MF A01		DE89787760/JAW	MF-000
P–					
300-89-015	14:45226	*See* CEC–9016060			
PARAMETER/IE–					
181	14:45082	*See* NUREG/CR–5290			
PARAMETER/NRC–					
178	14:45026	*See* NUREG/CR–5287			
PATENTS-USA–					
4,814,768	14:44474	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,828,052	14:44498	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,824,447	14:44499	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,829,008	14:44617	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,829,191	14:44832	Patent and Trademark Office, Box 9, Washington, DC 20232			
7-349,736	14:45017	NTIS, PC A03/MF A01			ND-00
4,825,769	14:45161	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,827,606	14:45318	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,824,742	14:45319	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,827,773	14:45443	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,812,280	14:45550	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,824,598	14:45581	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,817,101	14:45718	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,812,520	14:45719	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,810,474	14:45720	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,812,210	14:45722	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,812,577	14:45740	Patent and Trademark Office, Box 9, Washington, DC 20232			
7-335,632	14:45782	NTIS, PC A02/MF A01			ND-00
4,827,479	14:45838	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,828,453	14:45872	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,825,038	14:45873	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,829,246	14:45878	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,828,691	14:45889	Patent and Trademark Office, Box 9, Washington, DC 20232			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
4,810,846	14:46026	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,814,091	14:46180	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,826,966	14:46205	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,824,547	14:46206	Patent and Trademark Office, Box 9, Washington, DC 20232			
7-234,101	14:46272	NTIS, PC A03/MF A01			ND-00
4,816,205	14:46732	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,812,715	14:46733	Patent and Trademark Office, Box 9, Washington, DC 20232			
4,811,349	14:46734	Patent and Trademark Office, Box 9, Washington, DC 20232			
PB–					
89-126148/XAB	14:46185	NTIS, PC A04/MF A01			ND-00
89-139950/XAB	14:46379	NTIS, PC A04/MF A01			ND-00
89-183032/XAB	14:46093	NTIS, PC A06/MF A01			ND-00
89-183040/XAB	14:46094	NTIS, PC A09/MF A01			ND-00
89-183057/XAB	14:46327	NTIS, PC A04/MF A01			ND-00
89-185367/XAB	14:46763	NTIS, PC EE03/MF A01			ND-00
89-189773/XAB	14:46328	NTIS, PC A04/MF A01			ND-00
89-189856/XAB	14:46095	NTIS, PC A08/MF A01			ND-00
89-190235/XAB	14:45104	NTIS, PC A03/MF A01			ND-00
89-190573/XAB	14:46173	NTIS, PC A13/MF A01			ND-00
89-191175/XAB	14:46096	NTIS, PC A04/MF A01			ND-00
89-191381/XAB	14:44518	NTIS, PC A05/MF A01			ND-00
89-192520/XAB	14:45183	NTIS, PC A08/MF A01			ND-00
89-192587/XAB	14:46174	NTIS, PC A03/MF A01			ND-00
89-192983/XAB	14:46162	NTIS, PC A17/MF A01			ND-00
89-193353/XAB	14:45449	NTIS, PC A03/MF A01			ND-00
89-193361/XAB	14:46186	NTIS, PC A05/MF A01			ND-00
89-193395/XAB	14:46141	NTIS, PC A06/MF A01			ND-00
89-193973/XAB	14:45450	NTIS, PC A03/MF A01			ND-00
89-194286/XAB	14:44519	NTIS, PC A04/MF A01			ND-00
89-194294/XAB	14:46097	NTIS, PC A04/MF A01			ND-00
89-194385/XAB	14:46187	NTIS, PC A03/MF A01			ND-00
89-194864/XAB	14:46098	NTIS, PC A03/MF A01			ND-00
89-195382/XAB	14:45198	NTIS, PC A04			ND-00
89-195796/XAB	14:44426	NTIS, PC A06/MF A01			ND-00
89-197107/XAB	14:45425	NTIS, PC A16/MF A01			ND-00
89-197115/XAB	14:46175	NTIS, PC A06/MF A01			ND-00
89-197131/XAB	14:45417	NTIS, PC A06/MF A01			ND-00
89-197222/XAB	14:46099	NTIS, PC A12/MF A01			ND-00
89-197495/XAB	14:46176	NTIS, PC A02/MF A01			ND-00
89-197768/XAB	14:46142	NTIS, PC A02/MF A01			ND-00
89-197800/XAB	14:44461	NTIS, PC A07/MF A01			ND-00
89-200208/XAB	14:46045	NTIS, PC A10/MF A01			ND-00
89-200240/XAB	14:46329	NTIS, PC A16/MF A01			ND-00
89-200398/XAB	14:46177	NTIS, PC A09/MF A01			ND-00
89-200406/XAB	14:46178	NTIS, PC A13/MF A01			ND-00
89-200810/XAB	14:44445	NTIS, PC A09/MF A01			ND-00
89-201453/XAB	14:44447	NTIS, PC A03/MF A01			ND-00
89-201859/XAB	14:46100	NTIS, PC A03/MF A01			ND-00
89-201875/XAB	14:46330	NTIS, PC A05/MF A01			ND-00
89-203525/XAB	14:45311	NTIS, PC A04/MF A01			ND-00
89-203699/XAB	14:45001	NTIS, PC A03/MF A01			ND-00
89-203707/XAB	14:45002	NTIS, PC A03/MF A01			ND-00
89-203731/XAB	14:45003	NTIS, PC A08/MF A01			ND-00
89-203780/XAB	14:45184	NTIS, PC A03/MF A01			ND-00
89-204028/XAB	14:44618	NTIS, PC A07/MF A01			ND-00
89-204051/XAB	14:44604	NTIS, PC A03/MF A01			ND-00
89-204564/XAB	14:44605	NTIS, PC A08/MF A01			ND-00
89-204572/XAB	14:44614	NTIS, PC A04/MF A01			ND-00
89-204580/XAB	14:44606	NTIS, PC A03/MF A01			ND-00
89-204648/XAB	14:44520	NTIS, PC A03/MF A01			ND-00
89-204770/XAB	14:46188	NTIS, PC A04/MF A01			ND-00
89-204820/XAB	14:46153	NTIS, PC A03/MF A01			ND-00
89-205082/XAB	14:45317	NTIS, PC A03/MF A01			ND-00
89-205116/XAB	14:44607	NTIS, PC A12/MF A01			ND-00

PB–

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-205470/XAB	14:44500	NTIS, PC A05/MF A01			ND-00
89-206635/XAB	14:46101	NTIS, PC A02/MF A01			ND-00
89-206668/XAB	14:46102	NTIS, PC A03/MF A01			ND-00
89-207419/XAB	14:44615	NTIS, PC A03/MF A01			ND-00
89-207427/XAB	14:44616	NTIS, PC A06/MF A01			ND-00
89-209357/XAB	14:46788	NTIS, PC A07/MF A01			ND-00
89-209829/XAB	14:45418	NTIS, PC A04/MF A01			ND-00
89-211684/XAB	14:45426	NTIS, PC A03/MF A01			ND-00
89-856249/XAB	14:45565	NTISPC N01/MF N01			ND-00
89-865653/XAB	14:45427	NTISPC N01/MF N01			ND-00
89-865711/XAB	14:46103	NTISPC N01/MF N01			ND-00
89-865745/XAB	14:45428	NTISPC N01/MF N01			ND-00
89-865786/XAB	14:46104	NTISPC N01/MF N01			ND-00
89-865893/XAB	14:46105	NTISPC N01/MF N01			ND-00
89-866008/XAB	14:45539	NTISPC N01/MF N01			ND-00
89-866032/XAB	14:45624	NTISPC N01/MF N01			ND-00
89-866040/XAB	14:46331	NTISPC N01/MF N01			ND-00
89-866123/XAB	14:45540	NTISPC N01/MF N01			ND-00
89-866131/XAB	14:45541	NTISPC N01/MF N01			ND-00
89-866289/XAB	14:45165	NTISPC N01/MF N01			ND-00
89-866347/XAB	14:44521	NTISPC N01/MF N01			ND-00
89-866362/XAB	14:46179	NTISPC N01/MF N01			ND-00
PFC/IR–					
89-1	14:46678	*See* DOE/ET/51013–273			
PFC/RR–					
89-9	14:46676	*See* DOE/ET/51013–271			
89-10	14:46703	*See* DOE/ET/51013–T214			
89-11	14:46677	*See* DOE/ET/51013–272			
PIFR–					
4032	14:45898	*See* SAND–89-7066			
PMA–					
1988/1-6	14:45236	Petroleum Monitoring Agency, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
PNFI–					
PI-X-59F	14:44898	Petawawa National Forestry Institute, Library, Forestry Canada, Chalk River, ON, CAN K0J 1J0; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
PNL–					
6279-Vol.10	14:46063	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016175/JAW	MF-605
6450-21-HEDR	14:46313	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016242/JAW	MF-707
6673	14:45220	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015623/JAW	MF-350
6735	14:45379	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015209/JAW	MF-350
6887	14:45495	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015171/JAW	MF-000
6906-Vol.2	14:44764	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015191/JAW	MF-812
6906-Vol.3	14:44765	NTIS, PC A08/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015189/JAW	MF-812
6921	14:44983	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015203/JAW	MF-261
6925	14:46778	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016245/JAW	MF-000
6926	14:46779	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016243/JAW	MF-000
6927	14:46780	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016240/JAW	MF-705
6935	14:45419	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015170/JAW	MF-202
6942	14:45177	NTIS, PC A13/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015199/JAW	MF-600
PNL-SA–					
15701	14:44900	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016567/JAW	MF-245
16415	14:45397	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016565/JAW	MF-506
16438	14:46721	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016047/JAW	MF-420
16451	14:45380	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016566/JAW	MF-350
16651	14:45625	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016028/JAW	MF-401
16973	14:45029	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016822/JAW	MF-504
16974	14:45030	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016823/JAW	MF-523
17038	14:45166	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016825/JAW	MF-331;MN-212
17213	14:45496	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016827/JAW	MF-504
17216	14:45420	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015172/JAW	MF-311
17221	14:46764	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016828/JAW	MF-505

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
17268	14:44901	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016389/JAW	MF-000
PPPL–					
2629	14:46689	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016932/JAW	PC-420
2638	14:46690	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016021/JAW	PC-420;STD-426
2642	14:46722	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016954/JAW	PC-425
PPRP/PPER-R–					
10	14:46185	*See* PB–89-126148/XAB			
PR–					
178-516	14:44612	*See* AGA–9015613			
178-717	14:44612	*See* AGA–9015613			
189-715	14:44610	*See* AGA–9015610			
3-505	14:44611	*See* AGA–9015612			
3-703	14:45750	*See* AGA–9015611			
PR-PHS-HS–					
1	14:46738	*See* AECL–9263			
3	14:46281	*See* AECL–9504			
PR-PHS-P–					
2	14:46425	*See* AECL–9351			
PUB–					
668	14:46096	*See* PB–89-191175/XAB			
RAL–					
89-021	14:46475	British Library, Lending Division, Boston Spa, Wetherby, West Yorks.			ND-000
89-038	14:46476	British Library, Lending Division, Boston Spa, Wetherby, West Yorks.			ND-000
RAND/N–					
2614-NA	14:46043	*See* AD-A–208073/7/XAB			
REG/G–					
1.85-Rev.26	14:45031	NTIS, PC A03/MF A01 - GPO; OSTI; INIS		TI89015580/JAW	MF-000
3.48-Rev.1	14:44766	NTIS, PC A05/MF A01 - GPO - OSTI		TI89016451/JAW	MF-000
REPT–					
88-88	14:46763	*See* PB–89-185367/XAB			
RER–					
092	14:44522	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
RF-SPS-A–					
44/85	14:45888	NTIS (US Sales Only), PC A05/MF A01		DE89914786/JAW	MF-000
RSI–					
0327	14:46767	*See* SAND–89-1055			
0329	14:46067	*See* SAND–89-7099			
RTI–					
3798/00-01F	14:46094	*See* PB–89-183040/XAB			
SAND–					
86-1054	14:44767	NTIS, PC A06/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016927/JAW	MF-721
88-1187	14:45103	*See* NUREG/CR–5155			
88-1765	14:45867	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016673/JAW	MF-705
88-1849C	14:45072	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010230/JAW	MF-520
88-1882C	14:45073	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011539/JAW	MF-520
88-2161C	14:45074	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011534/JAW	MF-000
88-2171C	14:45153	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011537/JAW	MF-000
88-2172C	14:45075	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89010770/JAW	MF-704
88-2385C	14:46035	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007641/JAW	MF-706
88-2465C	14:46036	NTIS, PC A02/MF A01 - OSTI		DE89010229/JAW	MF-706
88-2618C	14:46037	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016540/JAW	MF-741
88-2766C	14:46038	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89007642/JAW	MF-706
88-2862C	14:44920	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016032/JAW	MF-700
88-2896	14:46765	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016930/JAW	MF-705
88-3045	14:45771	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89009571/JAW	PC-722
88-3262	14:44468	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016928/JAW	MF-126
88-3298	14:44598	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015198/JAW	MF-132
88-3470C	14:46064	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012663/JAW	MF-700
88-3471C	14:46065	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012664/JAW	MF-700
88-3482	14:46354	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016929/JAW	MF-705
88-7145	14:44759	*See* NUREG/CR–5367			
89-0194C	14:45772	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016177/JAW	MF-706

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
89-0220C	14:46766	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016186/JAW	MF-706
89-0252C	14:45162	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012496/JAW	MF-202
89-0271C	14:45853	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011449/JAW	MF-741
89-0320C	14:46039	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013811/JAW	MF-741
89-0339C	14:44902	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013812/JAW	MF-275
89-0482C	14:45726	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013922/JAW	MF-741
89-0544C	14:45868	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008110/JAW	MF-706
89-0545C	14:45566	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008116/JAW	MF-704
89-0549	14:45773	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016922/JAW	MF-722
89-0700C	14:45167	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009931/JAW	MF-212
89-0725C	14:44439	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011511/JAW	MF-705;MN-701
89-0781C	14:45774	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016880/JAW	MF-700
89-0788C	14:45775	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014133/JAW	MF-706
89-0832	14:46055	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016921/JAW	MF-703
89-0833	14:45776	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015167/JAW	MF-706
89-0839C	14:44944	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016034/JAW	MF-236
89-0841C	14:45869	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013494/JAW	MF-706
89-0848C	14:45567	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016031/JAW	MF-704;MN-706
89-0853C	14:44427	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011542/JAW	MF-108
89-0871C	14:45727	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011536/JAW	MF-701
89-0883C	14:44428	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011841/JAW	MF-108
89-0901	14:46723	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015200/JAW	PC-420;STD-421;STD-422;STD-423;STD-424;STD-425;STSTDS;STD-427
89-0919C	14:45777	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016182/JAW	MF-706
89-0920C	14:45497	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016877/JAW	MF-704
89-0933C	14:45498	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016029/JAW	MF-000
89-0967C	14:45568	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016876/JAW	MF-704
89-0990C	14:45696	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016528/JAW	MF-741
89-0998C	14:45499	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016539/JAW	MF-704
89-1022C	14:45569	NTIS, PC A02/MF A01 - OSTI		DE89016538/JAW	MF-704
89-1043C	14:46040	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016811/JAW	MF-741
89-1055	14:46767	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016924/JAW	MF-705
89-1056C	14:45836	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016526/JAW	MF-706
89-1086C	14:45078	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016033/JAW	MF-741
89-1099C	14:45076	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013582/JAW	MF-000
89-1161C	14:46066	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012495/JAW	MF-706
89-1180C	14:45745	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016414/JAW	MF-700
89-1216C	14:44429	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013587/JAW	MF-108
89-1243	14:46046	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014019/JAW	MF-700
89-1331	14:45500	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015197/JAW	MF-706
89-1331C	14:45501	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016417/JAW	MF-742
89-1398C	14:44837	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016185/JAW	MF-701
89-1452C	14:46768	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013070/JAW	MF-705
89-1492	14:46737	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015165/JAW	MF-700
89-1502	14:46781	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015194/JAW	MF-905
89-1542C	14:46769	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013934/JAW	MF-705
89-1625C	14:45870	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015122/JAW	MF-706
89-1863C	14:45154	NTIS, PC A08/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016368/JAW	MF-530
89-1881C	14:45778	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015120/JAW	MF-706
89-2013C	14:45570	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016883/JAW	MF-704
89-7035	14:44903	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015196/JAW	MF-274
89-7066	14:45898	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015195/JAW	MF-706
89-7072C	14:44430	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015410/JAW	MF-108
89-7073	14:45962	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015192/JAW	MF-414
89-7099	14:46067	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015166/JAW	MF-705
89-7101C	14:46660	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015888/JAW	MF-706
89-8242	14:45502	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015181/JAW	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
SARE–					
M91-7-43-1989E	14:44885	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SCIENTIFIC–					
1	14:46364	*See* AD-A–207876/4/XAB			
2	14:46365	*See* AD-A–207955/6/XAB			
3	14:46366	*See* AD-A–207956/4/XAB			
4	14:46367	*See* AD-A–208151/1/XAB			
SEASF-TR–					
89-001	14:46061	*See* LA-SUB–89-1			
SERI/CP–					
211-3550	14:44904	NTIS, PC A10/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009457/JAW	MF-273
SERI/SP–					
231-3521	14:44905	NTIS, PC A20/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009460/JAW	MF-246
SERI/STR–					
211-3529	14:44906	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009440/JAW	MF-273
211-3539	14:44907	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009451/JAW	MF-270
211-3540	14:44908	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009450/JAW	MF-270
217-3463	14:44984	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009442/JAW	MF-261
SERI/TR–					
215-3195	14:44985	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89009432/JAW	MF-261
SF–					
8903	14:45185	Saskatchewan Legislative Library, Government Publications, 234 Legislative Bldgs., Regina, SK, CAN S4S 0B3; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SFB–					
151-12	14:45779	Copy held by UB/TIB Hannover.			MF-000
SGD–					
531-PT-2	14:46379	*See* PB–89-139950/XAB			
SI-R–					
851203-1	14:45381	NTIS (US Sales Only), PC A03/MF A01		DE89914767/JAW	MF-000
851203-4	14:45004	NTIS (US Sales Only), PC A03/MF A01		DE89914766/JAW	MF-000
8512203-3	14:45429	NTIS (US Sales Only), PC A03/MF A01		DE89914765/JAW	MF-000
860220-3	14:45697	NTIS (US Sales Only), PC A03		DE89914746/JAW	MF-000
871208-3	14:44523	NTIS (US Sales Only), PC A05		DE89914749/JAW	MF-000
SJF-Orientering–					
57	14:44871	NTIS (US Sales Only), PC A02/MF A01		DE89914638/JAW	MF-000
SKB-TR–					
88-27	14:45729	NTIS (US Sales Only), PC A03/MF A01		DE89912023/JAW	MF-000
SLAC–					
340	14:45963	NTIS, PC A11/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015620/JAW	PC-414
SLAC-PUB–					
4920	14:45935	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015629/JAW	PC-414
4997	14:46439	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016688/JAW	PC-414
5002	14:46003	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015630/JAW	PC-414
5004	14:46440	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016689/JAW	PC-414
5005	14:46441	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016690/JAW	PC-414
5016	14:46004	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016692/JAW	PC-414
5018	14:46477	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016691/JAW	PC-414
5022	14:46505	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016942/JAW	PC-414
5024	14:45917	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015631/JAW	PC-414
5025	14:46478	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015632/JAW	PC-414
5026	14:45964	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015633/JAW	PC-414
5030	14:46479	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015634/JAW	PC-414
5034	14:45965	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016944/JAW	PC-414
5038	14:45977	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015635/JAW	PC-414
5040	14:46005	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016945/JAW	PC-414
5042	14:46006	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016946/JAW	PC-414
5046	14:46442	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015636/JAW	PC-414
5049	14:45936	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015637/JAW	PC-414
5050	14:45966	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015638/JAW	PC-414
5051	14:46480	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015639/JAW	PC-414
5054	14:45967	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015640/JAW	PC-414
5059	14:45968	NTIS, PC A02/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016949/JAW	PC-414

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
SLAC-PUB–					
5081	14:46443	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016950/JAW	PC-414
5083	14:46481	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016951/JAW	PC-414
SNO–					
87-4	14:45982	*See* AECL–9432			
SPC–					
1988	14:45301	Saskatchewan Power Corporation, 2025 Victoria Ave., Regina, SK, CAN S4P 0S1; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SPRU-DRC-DP–					
40	14:45057	the British Library Document Supply Centre, Boston Spa, Wetherby, West Yorks. LS23 7BQ			ND-000
SRC/PD–					
P-110-82-E-88	14:44496	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
SSI-TR–					
152	14:46057	*See* AD-A–207667/7/XAB			
STAN-CS–					
88-1212	14:46742	*See* AD-A–207802/0/XAB			
STEV-EO–					
89-13	14:44909	NTIS (US Sales Only), PC A06/MF A01		DE89914791/JAW	MF-000
89-14	14:44910	NTIS (US Sales Only), PC A03/MF A01		DE89914792/JAW	MF-000
89-15	14:44911	NTIS (US Sales Only), PC A05/MF A01		DE89914793/JAW	MF-000
STEV-LS–					
89-1	14:45382	NTIS (US Sales Only), PC A04/MF A01		DE89914795/JAW	MF-000
STEV-TB–					
89-3	14:44872	NTIS (US Sales Only), PC A03/MF A01		DE89914796/JAW	MF-000
STEV-TORV–					
89-6	14:44448	NTIS (US Sales Only), PC A06/MF A01		DE89914797/JAW	MF-000
STEV-VK–					
89-2	14:44912	NTIS (US Sales Only), PC A04/MF A01		DE89914794/JAW	MF-000
STF–					
15A88037	14:45199	NTIS (US Sales Only), PC A04/MF A01		DE89914785/JAW	MF-000
75A88022	14:44497	NTIS (US Sales Only), PC A02/MF A01		DE89914735/JAW	MF-000
SV-UG–					
1989-13	14:44619	NTIS (US Sales Only), PC A03/MF A01		DE89914802/JAW	MF-000
1989-20	14:44599	NTIS (US Sales Only), PC A05/MF A01		DE89914801/JAW	MF-000
SV-UL–					
1989-18	14:44448	*See* STEV-TORV–89-6			
SV-UM–					
1988-40	14:44913	NTIS (US Sales Only), PC A03/MF A01		DE89914799/JAW	MF-000
SV-UP–					
1989-14	14:44974	NTIS (US Sales Only), PC A04/MF A01		DE89914800/JAW	MF-000
SV-US–					
1989-11	14:44873	NTIS (US Sales Only), PC A04/MF A01		DE89914803/JAW	MF-000
SWRI–					
12-6253	14:46338	*See* DOE/RA/50219–T9			
TD–					
2699	14:46778	*See* PNL–6925			
2699	14:46779	*See* PNL–6926			
2699	14:46780	*See* PNL–6927			
TETRAT-TC–					
3338-28	14:46329	*See* PB–89-200240/XAB			
TR–					
11	14:46414	*See* AD-A–207716/2/XAB			
20	14:45518	*See* AD-A–207978/8/XAB			
29	14:45521	*See* AD-A–208232/9/XAB			
820	14:45862	*See* AD-A–207921/8/XAB			
88-11	14:44607	*See* PB–89-205116/XAB			
TR-DM–					
13	14:44711	*See* DOE-RW–89.029			

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
TU/CEA–					
19881	14:44621	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
19882	14:44622	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; PRICES UPON REQUEST, FUNDS CAN; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
G-288	14:44914	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $3.40 CAN minimum, plus $0.25/p after 10 pages			ND-000
TUBIK–					
62	14:45106	NTIS (US Sales Only), PC A03/MF A01		DE89914956/JAW	MF-000
TWE–					
C-172	14:44915	CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1. $3.40 CAN minimum, plus $0.25/p after 10 pages; MF $10 CAN.			ND-000
TYOT-JULK–					
302	14:45383	NTIS (US Sales Only), PC A05/MF A01		DE89787747/JAW	MF-000
304	14:45384	NTIS (US Sales Only), PC A06/MF A01		DE89787748/JAW	MF-000
305	14:45385	NTIS (US Sales Only), PC A06/MF A01		DE89787746/JAW	MF-000
306	14:45302	NTIS (US Sales Only), PC A05/MF A01		DE89787745/JAW	MF-000
UA–					
9016436	14:45200	NTIS, PC A03/MF A01 - OSTI		DE89016436/JAW	MF-000
UBA-FB–					
87-091	14:45446	Copy held by UB/TIB Hannover.			MF-000
89-020	14:45442	Copy held by UB/TIB Hannover.			MF-000
89-031/1	14:46106	Copy held by UB/TIB Hannover.			MF-000
89-031/2	14:46107	Copy held by UB/TIB Hannover.			MF-000
89-037	14:44916	Copy held by UB/TIB Hannover.			MF-000
UCID–					
19227-88	14:45303	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015186/JAW	MF-121
20664-88	14:46770	NTIS, PC A07/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015618/JAW	MF-705
21600	14:44768	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015187/JAW	MF-810
21672	14:46315	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015616/JAW	MF-402
21736	14:46789	NTIS, PC A06/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015183/JAW	MF-705
21738	14:45044	NTIS, PC A04/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89015184/JAW	MF-000
21740	14:46771	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015185/JAW	MF-405
21742	14:45571	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015188/JAW	MF-701
UCLA–					
10-P25-112	14:46444	NTIS, PC A12/MF A01 - OSTI		DE89016006/JAW	MF-414
UCLA/PPG–					
1247	14:46724	NTIS, PC A04/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015622/JAW	PC-421;STD-423
UCRL–					
100242	14:46024	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89014045/JAW	MF-000
100283	14:46773	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016515/JAW	MF-705
100366	14:45969	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016500/JAW	MF-706
100511	14:46332	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89008611/JAW	MF-708
100525	14:45871	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016649/JAW	MF-706
100647	14:45572	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016637/JAW	MF-000
100650	14:45573	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015779/JAW	MF-000
100710	14:46380	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015775/JAW	MF-700
100718	14:45780	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011635/JAW	MF-505
100798	14:46725	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89012328/JAW	MF-712
100958	14:46774	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89011403/JAW	MF-705
100983	14:46381	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016509/JAW	MF-701
101175	14:46566	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016512/JAW	MF-700
101190	14:45781	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016502/JAW	MF-000
101208	14:46775	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89015118/JAW	MF-405
101252	14:44821	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016516/JAW	MF-705
101256	14:46776	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016523/JAW	MF-700

Report Number	Abstract Number	Source of Availability	GPO Dep.	Order Number	Distribution Category
101275	14:45504	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016636/JAW	MF-704;MN-701
101425	14:44822	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016517/JAW	MF-705
101426	14:44823	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016519/JAW	MF-705
101434	14:45698	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016504/JAW	MF-701
101488	14:45699	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016503/JAW	MF-701
101506	14:46661	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016508/JAW	MF-405;MN-406
101545	14:46630	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016518/JAW	MF-706
101547	14:45505	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016652/JAW	MF-706
101562	14:46422	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016506/JAW	MF-705
101570	14:44824	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016521/JAW	MF-705
101586	14:46506	NTIS, PC A02/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016505/JAW	MF-700
101717	14:46340	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016514/JAW	MF-701
21199	14:46108	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016510/JAW	MF-702
21200	14:46109	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016520/JAW	MF-702
53859-88	14:45201	NTIS, PC A03/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016953/JAW	PC-104;STD-109;STD-122;STD-123;STD-125;STD-132;STSTDS-510 403;STD-510
53921-th	14:46772	NTIS, PC A05/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89016498/JAW	MF-705
53934	14:45503	NTIS, PC A17/MF A01; OSTI; INIS; GPO Dep.	E 1.99:	DE89016714/JAW	MF-704
UCRL-Trans–					
12241	14:46041	NTIS, PC A03/MF A01 - OSTI; GPO Dep.	E 1.99:	DE89013799/JAW	MF-741
UILU-ENG–					
89-4005	14:46701	*See* AD-A–208129/7/XAB			
UNC-WRRI–					
88-241	14:46141	*See* PB–89-193395/XAB			
UNIES–					
M91-11-2-5-1989E	14:45386	Energy, Mines and Resources Canada, Communications Branch, 580 Booth St., Ottawa, ON, CAN K1A 0E4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
USGS-WRI–					
89-4065	14:44704	*See* DOE/ID–22080			
UTHEP–					
89-0701	14:46478	*See* SLAC-PUB–5025			
89-0702	14:46479	*See* SLAC-PUB–5030			
UTSI–					
89-03	14:45312	*See* DOE/ET/10815–128			
UW/GLI–					
EN57-27-1987-03	14:46189	Climate Program Office, Canadian Climate Centre, 4905 Dufferin Street, Downsview, ON, CAN N9B 3P4; $N/C; MF CANMET/TID, Energy, Mines and Resources Canada, 555 Booth St., Ottawa, Ont., Canada K1A 0G1; $10 CAN.			ND-000
UWIS/DC/TR–					
89/4	14:45583	*See* AD-A–208217/0/XAB			
89/5	14:45582	*See* AD-A–208216/2/XAB			
VTT-TIED–					
863	14:44874	NTIS (US Sales Only), PC A04/MF A01		DE89787758/JAW	MF-000
926	14:44881	NTIS (US Sales Only), PC A04/MF A01		DE89787755/JAW	MF-000
937	14:45387	NTIS (US Sales Only), PC A03/MF A01		DE89787757/JAW	MF-000
940	14:45388	NTIS (US Sales Only), PC A04/MF A01		DE89787754/JAW	MF-000
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RA Report analytic
B Book
BA Book analytic
P Patent
E Engineering materials
D Dissertation
TG Translation (general)
TA Translation (analytic)

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TD Chad
TG Togo
TH Thailand
TN Tunisia
TO Tonga
TR Turkey
TT Trinidad and Tobago
TW Taiwan
TZ United Republic of Tanzania

UA Ukrainian Soviet Socialist Republic (Ukrainian SSR)
UG Uganda
US United States of America (USA)
UY Uruguay

VA Holy See
VE Venezuela
VI Virgin Islands of the United States
VN Viet Nam

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